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NEW ELECTRIC LIGHTHOUSE OF CAPE HEVE.

ONE of the characteristics of the degree of civilization and progress of a maritime nation is to have well beaconed coasts, that is to say, perfectly indicated by the various known systems of lighthouses and signals. Good lighting is, upon the whole, a visible form of hospitality; it conciliates itself, too, with the strict interest of those who practice it, for navigators more willingly seek the shores upon which extends a tutelar cautionary than those strewed with unknown traps and reefs, and the cost of transportation lowers with the diminution of risk.

France, we are happy to state, is, from this point of view, in a very particularly flattering situation, thanks to the labors of its scientists and engineers. Our country has no equal in the construction and illumination of lighthouses. It suffices to cast a glance at the progress made in the construction of our powerful electric lighthouses to obtain an idea of the efforts that have been made and of the results attained.

It was in 1863 that the first electric lighthouse was installed at Cape Heve, near Havre. The intensity of its light was 6,000 carcel burners, that is to say, sensibly equal to that which could be obtained with lighting by mineral oil.

In 1881, Inspector-General Allard, thanks to a series of labors that do the greatest honor to French science, obtained an intensity of 127,000 carcel burners for the Planier lighthouse, near Marseilles, and the type of this structure has been employed since then for the Baleine, the Isle of Re, Calais, the mouth of the Canche, Gris-Nez, and Dunkirk.

But, soon afterward, new combinations in optical construction and in the system of rotation of the apparatus permitted of considerably increasing, without expense, the luminous power of the electric apparatus. At Ouessant, at Barfleur, and at Belle Isle, the latest improvements permitted of reaching the enormous figure of 900,000 carcels.

This extraordinary power has only passed by, itself, to give place to the new scintillating light of Engineer-in-Chief Bourdelles, which is going to be put in service at Cape Heve, and a model of which figures in the French section of the Chicago Exposition. The new apparatus, constituting a true revolution in even the most recent processes, possesses a power of 2,500,000 burners, say 1,700,000 carcels more than in the most powerful lighthouse that exists.

At the moment that this splendid apparatus is about to throw its first luminous beams into space, at the same time that it will obtain at Chicago a true triumph for French science, a few details on this subject will be read with interest.

Up to 1770 (it is scarcely a century ago), the few lighthouses existing upon the coast of France, such as those of Cordonan and the Isle of Re, were lighted by means of heaps of wood burning in the open air at the tops of towers. In 1774, this system was in use at the lighthouse of Heve.

In 1781, oil lamps were used for the first time for this same lighthouse.

Starting from 1783, upon the initiative of Teulere, engineer-in-chief of the generality of Bordeaux, the lamp with double current of air and the parabolic reflector already indicated by Lavoisier came into use for lighthouses.

Lemoyne, Mayor of Dieppe in 1784, devised the eclipse lights, capable of giving lighthouses distinct characters, and Bordier Marcet, in 1811, created the double parabolic reflector. But it is to Fresnel, appointed a member of the lighthouse commission in 1811, that is due the realization of the great progress that is daily being made and that consists in the adaptation of lenticular apparatus to lighthouses in place of reflecting ones.

The property possessed by converging lenses of refracting or sending parallel to their axis the luminous rays emanating from their source allows them to render the same service as parabolic reflectors. But their execution on a large scale, for lighthouse apparatus, would require such a mass of glass that it would be impossible either to work or to manage it. It therefore occurred to Fresnel, in order to render the use of them easy, to compose them of a central part surrounded by concentric rings projecting beyond one another, and representing, so to speak, the edges of a series of lenses of various radii having a common focus at which the luminous source is situated. Buffon had already conceived this idea and had proposed to establish echelon lenses, shaped out of a single piece.

Fresnel contented himself with separate pieces shaped apart and united with each other by fish glue. His system, besides, presents a considerable advantage: the passage of the light through the thin lenses absorbs, in fact, only one-tenth of the luminous intensity developed, while the reflecting polished surfaces absorb half of it.

On July 25 1823, an apparatus of this kind was put in service on the tower of Cordonan Fresnel rendered it very perfect by sending toward the horizon by means of lenses and mirrors the luminous rays that the lamp sends above and below the optical drum. He gave it a regular rotary motion through the addition to the mechanism of a regulating pendulum. Finally, he rendered it complete by the addition of catadioptric rings replacing the combination of mirrors and lenses that we have just spoken of. These rings, based upon the phenomenon of total reflection by means of prisms, allowed none of the luminous intensity produced to be lost. Argand, Quinquet, and Carcel kept improving the very delicate construction of the powerful lamps of lighthouses up to the time when electricity, under the form of the voltaic arc, came to furnish its extraordinary luminous power, and, thanks to the improvement of electric machines, to put it at the disposal of engineers. In 1863, as we have said, the dazzling electric light produced by the magneto-electric machines of the alliance took possession of the Heve lighthouse. The arc lamps employed were of the Serrin system, consisting of two rods of carbon between which the voltaic arc formed.

The result was excellent, and in a near future it is certain that all lighthouses of importance in France and elsewhere will be lighted by electricity.

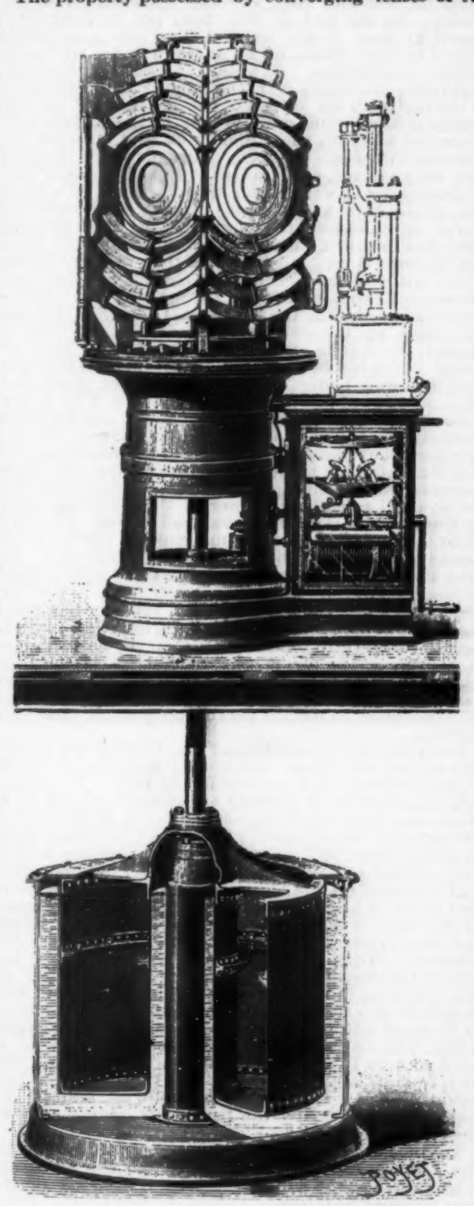
The optical system devised by Mr. Bourdelles as a substitute for the old stationary lights, and the new installation of which at the Heve lighthouse realizes a magistral application, consists of an apparatus emitting white flashes that succeed each other every five seconds. It presents the peculiarity, as compared with the old apparatus, that the number of lenticular panels, which in the old lighthouses was twenty-four, as shown in one of the figures, which in lighthouses of the first rank varies from eight to sixteen, is reduced to four only.

The principal difficulty consists in causing the panels to revolve with the necessary velocity to have the flashes produced at sufficiently short intervals. This difficulty being conquered, it is evident that the luminous intensity developed by the focus can be utilized in a more and more extended manner. In fact, in a twenty-four panel apparatus, each panel receives the twenty-fourth part of the light emitted. Let us suppose the number of panels reduced to four, and each will receive six times more light than in the old system. This is what occurs at the new Heve lighthouse.

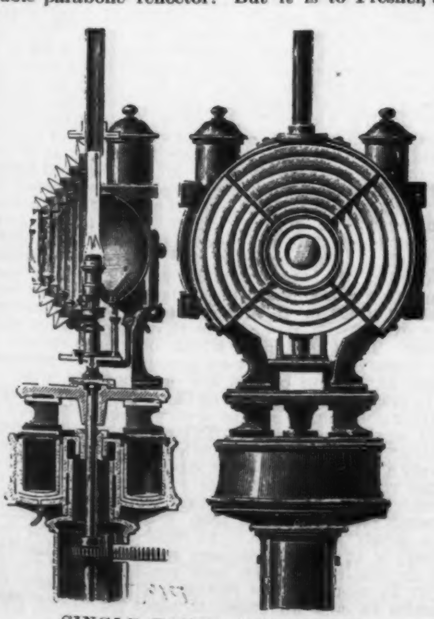
The difficulty in the way of rapid rotation has been surmounted by Engineer Bourdelles as follows:

The optical panels, which are very heavy, are supported by a float placed in a bath of mercury. The thrust of the liquid, as indicated by the principle of Archimedes, balances the charges. Hence the stress to set the apparatus in revolution, and which would be considerable with the usual mechanical methods, is reduced to the simple proportions of the friction of the float against the mercury.

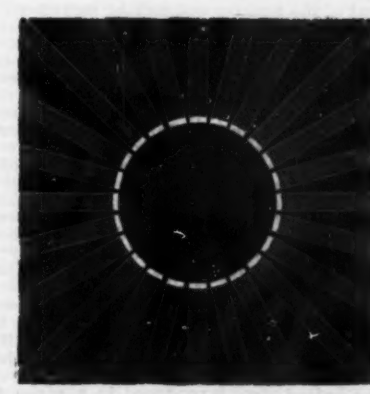
Messrs. Sautter, Harle & Co., of Paris, have realized this arrangement, devised by Mr. Bourdelles, with a



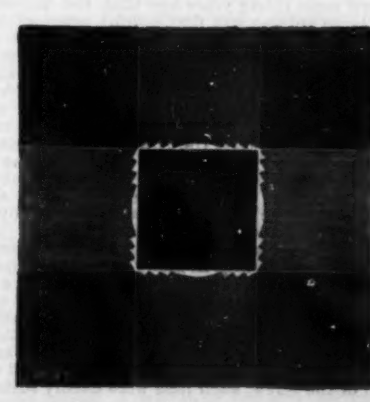
THE NEW HEVE LIGHTHOUSE WITH ITS FLOAT.



SINGLE PANEL APPARATUS.



DISTRIBUTION OF THE LIGHT EMITTED BY A TWENTY-FOUR PANEL LIGHTHOUSE.



DISTRIBUTION OF THE LIGHT EMITTED BY A FOUR PANEL LIGHTHOUSE (THE HEVE LIGHTHOUSE).

rare perfection. It results that with the use of a very feeble motive power the new Heve lighthouse will be easily able to effect a complete revolution in 20 seconds, while in the first-class lighthouses of ordinary type a complete revolution requires 4 minutes at a minimum, that is to say, twelve times longer.

Our first engraving shows this arrangement. With its four panels it gives a luminous intensity of 2,500,000 carcel burners. Such is the astonishing beam of light that will regularly escape from the new lighthouse, which will be the most powerful in the world. If it were not necessary to take into account the sphericity of the earth and accidents of the surface, its light would be perceived at 30 kilometers beyond Paris.

During eleven-twelfths of the year—eleven days out of twelve, if you please—the new Heve lighthouse, thanks to its luminous power, will be visible, despite the absorption of light by fogs, in the whole extent of its geographical range, which is 23 nautical miles, that is to say, 42·5 kilometers. The old stationary lights realized their geographical range, which it is unnecessary to say was very inferior, only during eight-twelfths of the year at the most. We shall not enter into the technical details of the construction of this splendid apparatus, as that would be out of our province. Let us merely say that the electric lamp that will serve as a luminous source will have a mean intensity of 1,000 carcels, and that the total weight to be revolved is about one ton. The proportions of the pieces that constitute this powerful lighthouse are therefore relatively reduced, and show how profound in all its details has been the study of the engineer who devised them.

Will the very respectable luminous intensity of 2,500,000 carcels be exceeded? It does not seem, we hasten to say, as if a very serious practical interest can be found in it, since the world is round, the geographical range of lighthouses is necessarily limited, and a lighthouse that sends its beams to more than 40 kilometers from the coast almost constantly gives navigators indications that appear to be more than sufficient.

However, in pursuing to its extreme limits the principle so ably laid down by Mr. Bourdelles, there is nothing to prevent the construction of lighthouses with two panels, or even one. The lighthouse with two panels would give an intensity of 5,000,000 carcels. Such is the intensity, it seems, that will be possessed by the Eckmuhl lighthouse, which is to be erected at the point of Penmarch by virtue of a testamentary disposition of Madam de Blocqueville. By replacing one of the panels by a spherical reflecting mirror, the electric lamp of which would occupy the center, one would reach, in neglecting a few losses due to reflection and refraction, the intensity of 10,000,000 carcels. The lighthouse commission has had a model of these two apparatus constructed, but it is an oil lamp that serves as a luminous source. However this may be, we shall be able, provided that it is desired, to illuminate a lighthouse of 10,000,000 carcels at the Universal Exposition of 1900.—*L'Illustration.*

THE APPLICATION OF AIR IN MOTION TO CHEMICAL INDUSTRY.*

By Henry G. Watel, B.Sc.

It is only in recent years that the value of air in motion as applied to trade and industry has been at all recognized, and although a considerable amount of attention has been given to the subject, air in motion is not as fully applied as would no doubt be the case if manufacturers and others were more acquainted with the numerous services it can render.

I am not now speaking of the mere fact of churning air about in a room or in a machine, either by means of revolving paddles or swinging punkahs, both of which have been used, so to say, from time immemorial, but of the positive and certain movement and renewal of air, either warm or cold, moist or dry, by means of mechanical appliances, such as fans, blowing engines, etc. Of these, fans, except in special cases, have long ago proved themselves the most convenient of application and economical in use; but it is necessary at the outset to consider the immense difference between "pressure" and "volume." Except for the purpose of overcoming a very heavy resistance to the motion of the air, in most cases it is volume and not pressure that is required, although even now blowers and centrifugal fans are often improperly applied when open types of fans should be used. Of course for blast furnaces, smiths' fires, for lifting grain, heavy, coarse dust, etc., pressure is absolutely necessary; but this pressure is only obtained at very great expense, for the expenditure in moving air under pressure is practically porportional to the square of the pressure, or more, *i. e.*, to move the same volume of air at twice the pressure costs four times as much; and if this pressure is not required, three-quarters of the expenditure is wasted completely, and only three-quarters of the desired effect is produced in a given time. It is, therefore, more particularly to air in motion in large volume, but at low pressure, that I wish to call your attention.

It is now some thirty years ago that the movement of air in large volume was first sought after with the recognition of the fact that air will not displace itself alone without some impelling power; and the natural tendency of heated air to rise in a colder atmosphere was one of the first methods tried, but although the principle is correct, it is expensive. Many mines are still ventilated by means of a large furnace at the bottom of a shaft, and on the surface many buildings are still ventilated by means of a furnace at the base of a chimney. A Frenchman, M. Motte, was at that time, I believe, the first to attempt to move air in volume, with more certainty and less cost, by mechanical means, and the celebrated General Morin gave the subject considerable attention and applied mechanically driven fans in many cases. But the fans of that period were extremely inconvenient to apply, for they were simply Archimedean screws such as are used for lifting water. Now water is practically incompressible, while air is compressible, and the coefficient of slip is consequently very different; and as air needs, therefore, a comparatively high speed of revolution of the screw, such fans were hardly suited for general use.

In the same way, although for propelling ships by means of a screw the Archimedean screw was applied at first, it was soon found that a short screw, consisting of only the fraction of a turn instead of many turns, gave the best result; so it was also soon found that for moving air, instead of a long screw, a short screw, but at a higher speed of revolution, answered better. But another difficulty then appeared, which was that air, being much more mobile and compressible than water, could not be efficiently gripped by the fan, since, even under the slightest resistance, it was at once scattered centrifugally from the tips of the blades without being impelled forward to effect the desired purpose. Many devices were tried to overcome this defect, such as various shapes of blades, applied as in the Archimedean screw, a short length of tube round the fan, etc.; but it was not until the blades were bent over at the edge (so that although the air was perfectly free to enter under the blade, once under it the air could not escape) that the problem of moving air cheaply in large volume was solved. That the problem was solved is proved by the fact that there are now some 12,000 fans of this type in use for industrial purposes alone, displacing hourly over eight thousand million (8,000,000,000) cubic feet of air.

The problem of efficiently moving air in volume having thus been solved, it then became a question to study its best and most valuable applications to industry. As air had at first been put in motion by means of fires, it was natural that one application should be that of moving air through a fire to insure perfect combustion. Chemically speaking, combustion is the combination of the carbon and hydrogen of the fuel with the oxygen of the air, and, if the air supply is insufficient, more or less of the carbon will be carried away up the chimney as soot, thereby increasing the smoke nuisance; carbonic oxide escapes also unconsumed, and probably some hydrogen and hydrocarbons as well, which all contribute to vitiate the atmosphere and produce waste. Many will no doubt have noticed that immediately after putting fresh fuel on a fire, the amount of smoke issuing from the chimney is very much greater than at other times, which is due to the fact that the thicker fire does not allow the air to pass so freely through it, and also to the cold fuel chilling the ascensional power of the air and gases up the chimney. When the fire door is opened the smoke soon disappears, the air then arriving on the top of the fire as well as underneath, and thus insuring better combustion. Taking good coal with say 82 to 85 per cent. of carbon and 2 to 5 per cent. of ash, it is apparent that about six hundred thousand cubic feet of air per ton are necessary to insure perfect combustion. To obtain the movement of this amount of air through the fire during the time necessary for the disappearance of the ton of coal by the unaided ascensional power of the resulting gases up the chimney is generally impossible, but if plenty of air is supplied to the fire underneath the bars by means of a fan, the fuel is completely consumed. To take an extreme example, it would at first sight appear impossible to keep steam in a boiler with a fire six inches thick of the finest coal dust, yet this has been easily and completely burnt with the aid of an 18 inch fan, and only three-tenths of an inch of water gauge in pressure in the air it was delivering. Steam and heat being so universally in use in every industry, the value of their economical generation, and of the application of air in motion for this purpose, is therefore obvious.

From this it is also apparent that there is no necessity to use any great amount of pressure or water gauge for the perfect combustion of fuel. Of course, if it be a question of burning a maximum of fuel in a given time, more air to the square foot of grate surface will give the desired result; but it may be taken that anything above half an inch of water pressure is not only useless but detrimental, for many reasons; the coal is carried up the chimney by the rapid air current before it has time to burn completely, the strain on the boiler is enormously increased, and the tubes and flues both suffer; but the use of a slight air pressure is both economical and beneficial. For instance, the discharge through about 18 square feet of the area of an 84 inch Blackman at low speed into the stokehold of a steamer burning about 60 tons of coal in 24 hours effected a saving of about five tons of coal a day, with an increase of about three-quarters of a knot an hour in speed; although in this case the fan had been fitted up only for the ventilation of the holds, the water gauge was practically nil, and the air supply was limited by the fact of its having to pass through a bulkhead door.

To come now to the application of air in motion to the various chemical industries or to the materials manufactured, the subject may be considered under four different headings:

Removing heat, foul air, fumes, dust, steam, etc.
Warming.
Cooling.
Drying.

Apart from any question of the comfort of the workers, the removal of heat usually gives also a direct corresponding advantage, because the workers do their work better and quicker when in comfort, and give a direct increase of output. For instance, in a large cold air producing installation the temperature in the compressor room was about 120° F. It certainly seemed rather anomalous to be producing cold air in such a temperature, but the room would not ventilate itself. The application of a fan brought the temperature down to within two or three degrees of the outer air, and the natural result was that the compressors needed far less steam to drive them and gave a correspondingly greater output. In another instance, in a dynamo room, where considerations of silence practically precluded any ventilation, the temperature was often as high as 180° F. It being impossible to ventilate the room, a fan was fitted on the spindle of the dynamo, with the result that its output was increased 25 per cent. As an instance of the value of air in motion in removing foul air and fumes in nitro-phosphate and superphosphate works, the application of a fan to the den removes the fumes and acid vapors produced during the mixing, and later, when the men are digging out the mass, as they are working with a continual supply of fresh air arriving behind them, they are not incommoded by the remaining fumes, and can get to work sooner and work faster in consequence. Dust can also be removed, as in the grinding rooms of cement and pottery works, carding rooms, flax and jute mills, etc. And in many cases it is not only advisable for the comfort of the workers, but is also necessary to avoid the risk of explosion which nearly always exists when the air in a room is charged with particles of fine dust, should a light be incautiously introduced. Besides, in many industries, the dust is not only disagreeable, but is positively a source of disease. It is a well known fact, for instance, that in the woolen industry the fine dust arising in sorting the wool is charged with germs and microbes, which sooner or later produce the "wool sorters' disease." This has now, to a very large extent, been stamped out by the use of fans which draw away these germs before they can reach the mouths of the sorters. In grinding, the fine particles of steel and iron reaching the lungs become permanently embedded in them, with the most serious results. In white lead works the particles of lead in the air end by poisoning the workers, producing paralysis. In match works the fumes of phosphorus produce "phossy jaw," and in "silvering" the fumes of mercury have an equally disastrous effect upon those who breathe them. Explosive gases produced in any process are also easily removed by plenty of air in motion. And not only can these various dusts or fumes be removed, burnt, washed, or destroyed, but also in many cases where they have any value they can be collected; thus a nuisance is not only removed, but a direct source of income takes its place. A 42 inch fan recently applied to collecting charcoal dust is saving 130*l.* a year. In many industries the presence of steam is a continuous source of loss and trouble, for its condensation on the ceilings or floors overhead rots them, its condensation on the machines rusts and destroys them, and in many cases it is a direct source of danger, as the workers cannot see around them. As an instance of its successful removal, in a room of about 3,500 cubic feet, in spite of 24 gas jets, it was impossible to see one's hand before one's face. A fan was fitted, with the result that no gas was any longer necessary, that the saving in gas more than paid for the cost of running the fan, that there was no longer any condensation, and that in addition an excellent ventilation was obtained throughout the whole building.

For the purpose of warming for any desired object, air in motion will generally prove much more economical, in the first cost of erection and in maintenance, than any other method. In many cases steam pipes are still employed or even now erected where warm air in motion would give infinitely better results, and provide ventilation as well. The best steam boiler is at best but a more or less wasteful means of transmitting heat from one part of a factory to another, for the loss of heat by radiation is very great, not to mention the difficulty of keeping an expensive and complicated system of pipes in repair. By the use of air in motion it is easy to warm any room or building to any desired extent, and at so small a cost that 1,000 cubic feet of pure fresh air can be raised 50 deg. F. per minute, and constantly renewed, with an expenditure of gas coke not exceeding eight pounds per hour, and in many cases not exceeding six. Besides, in many cases heat is generated in one part of a building where its presence is far from desirable, but if this air is moved to another part of the same building, it is then available for warming at a nominal cost. Many high-pressure steam engines are at present in use, where the steam exhausts directly into the atmosphere. But if this steam were condensed by means of a coil of pipes and a fan, the immediate result would be that a large supply of pure warm air would be obtained, and that the rapid condensation of the steam producing a vacuum in the cylinder of the engine, either an increase of power or an economy of fuel would be realized at the same time. It has long ago been proved that if a fan is thus applied, the engine runs easier with the fan at work than when the fan is not. Another great advantage is also obtained, which is a supply of pure water, and, therefore, if this water, still more or less warm, is returned to the boiler, the deposition of scale is absolutely avoided.

The subject of cooling may be considered under two heads. 1. The cooling of a hot material or liquid down to the normal temperature. This is easily and rapidly obtained by the use of air in motion. The cooling effect may be increased by using wet surfaces or ice where the air is admitted, but the temperature of the material cannot be reduced very much below that of the air brought into contact with it. This application is nevertheless often of very considerable value. At a large rolling mill, situated on the top of a hill, the only water supply was obtained from a tiny brook and the rain water from the roofs. The mill was driven by a single cylinder engine of 3,000 h. p. It was, therefore, obviously impossible to condense the exhaust of this engine by the usual means, as there was not a hundredth part of the water necessary to fill a "lodge." But six 10 ft. fans, delivering nearly a million and a half of cubic feet of air per minute, were applied to cooling the water as it left the pumps, so that it could at once be used again, and with the most complete success. The pressure in the boilers being 75 lb., and the resulting vacuum being over 28 in., in rough figures, it is at once obvious that one-fifth of the horse power was gross profit, say 600 h. p. Taking from this the power expended in driving the fans, pumps, loss in friction, etc., amounting to about 200 h. p., there would have been a saving of 400 h. p., and it was in reality considerably over 300 h. p., or more than 10 per cent. clear saving. Thus the mills, which had been erected in this inconvenient locality on account of the presence of ore at the top of this hill or mountain, were by air in motion able, in spite of the other disadvantages of their position, to secure a very large reduction in their working expenses. Taking this subject from another point of view, it, of course, is in one sense merely a repetition of what has been already said as to the removal of heat. But it is often necessary to extend the cooling still further, or secondly, to cool or refrigerate substances from a normal temperature to a much lower one. In this case special machinery is, of course, necessary in addition to the fan, but the results are even here much better if the air is put in motion. For instance, it was formerly the practice in cold air stores to place the cooling pipes

* *Jour. of the Society of Chemical Industry.*

on the ceiling of the rooms, and to trust to the natural tendency of the colder air to fall and of the warmer air to rise, to insure a regular distribution of the cooling effect throughout the store. But now by the additional application of a fan or fans to put the air in motion with certainty, any dependence on the natural ascent of the warmer air to the cooling surface is completely avoided, and the air as fast as it is warmed by contact with the substances to be cooled is brought infallibly back to the cooling surface to be again reduced to the desired temperature.

The subject of drying is perhaps the one most generally interesting to all those engaged in chemical industries, and it has certainly until recently been one of the least understood. The general idea of drying appears to have been to get a room heated as much as possible, put the goods in it, leave them in until dry, not to trouble in the least degree about the resulting humidity, to trust to their drying if sufficient time was allowed, and in fact to trust to luck. That all this is exceedingly unpractical and wrong should be sufficiently apparent. In one of my early experiences of drying I was called into a series of rooms on a hot summer's day, and happened to be carrying a black leather bag. These rooms were used for drying a liquid for the purpose of obtaining the 1 or 2 per cent. of solid matter it contained, and were heated to some 150° F. At once on entering I found myself covered with a profuse cold perspiration, and on looking at my bag I saw it was simply streaming and running with water. I was told the drying in spite of very heavy expenditure was not satisfactory, and very slow, for each room contained some 400 pints of water to remove, and the remainder suffered from prolonged stewing. It never seemed to have occurred to the manufacturer that it was necessary to get rid of the resulting steam as quickly as possible, and I could quite understand that, in an atmosphere so charged with moisture that it could condense as rapidly as it did on the body, whose temperature is 98½° F., the material did not dry as fast as he would have wished.

As another instance, I have been called into a room containing goods heated to 150° or 160° F., with a very small percentage of water, and was told that they took 24 hours to dry. I offered to dry the goods in 24 minutes, and was told that these rooms had been fitted up by the firm's ancestor, who had made it a reputation of unrivaled quality, and was simply laughed at. However, after about a year's occasional visits the firm were finally brought to believe that it was just possible that something better might be done, and consented to try an experiment as they called it. With air in motion the result was that the goods dried thoroughly in 16 minutes, and that being no longer stewed, their appearance, beauty, brilliancy of color, and quality were such as had never been seen before.

In France I was called in to see some machines for drying cotton and woolen goods in the piece, which I was told cost each some 16s. a day for steam. They had been provided with air in motion, but the air was simply put in motion by means of revolving paddle wheels taking a lot of power, and simply churning the saturated air in the machines round and round inside them. The top of these machines was stuffed with rags and hay to the depth of some nine inches to absorb the water, which nevertheless was streaming down inside them; but again it had never occurred to the firm to remove the saturated air by putting air in motion as it should be; that is to say, to remove the water evaporated and not simply to churn it round and round inside the machine. Here I was told that if I introduced other air into the machines the temperature would fall to such an extent that no drying would be possible. They had never considered the fact that the air might be renewed so slowly that no perceptible fall of temperature would result, and that the damp air need not be discharged until it was absolutely saturated with moisture, when being as damp as it could possibly be, it could have no further drying power, and was consequently quite useless. The application of air in motion practically at once proved its value by much more rapid drying, better results, and about half the expenditure.

These few instances, which I could multiply by hundreds, should suffice to show what can be done in this direction, and at once suggest the remedy: Renew the air as may be necessary, and test the humidity of the air in the room or machine. For the latter purpose I wish to call your attention to the valuable indications afforded by a simple instrument, the psychrometer, which consists simply of a pair of thermometers, the bulb of one being kept continually moist by means of the water supplied to it through a cotton mesh and the muslin wrapped around it. Heat is abstracted from the mercury in the wet bulb, and the consequence is that it indicates a lower temperature than the dry one. The greater the degree of dryness of the air, the more rapid the evaporation, the greater the quantity of heat abstracted from the wet bulb, and consequently the greater the difference between the two readings. If the air is saturated there is of course no evaporation, and the two thermometers read precisely alike.

Therefore, to consider the matter roughly, the mere difference between the two readings is an indication of the drying power of the air, for the greater the difference between the two readings the drier the air, and consequently the greater its absorbing power for moisture. But to consider the matter accurately it is very easy to construct a table, based, it is true, on a somewhat complicated formula, and data investigated more exactly by Regnault than by any other scientist, which gives at sight the exact percentage of moisture in the air, and which therefore at once shows how near it is to its point of saturation, and how much more moisture it can take up.

This has long ago been done for the ordinary temperatures of the atmosphere for meteorological observations, say up to 100° F., but much higher temperatures are often necessary for drying rapidly certain classes of products. Some time back I received an inquiry from a firm for such a pair of thermometers for use in a drying room, the temperature of which was given me as 250° F. As may be at once seen the inquiry appeared at first sight rather extraordinary, considering the usual form of the instrument, for 250° being above the boiling point of water, the water in the tube would of course boil, and be expelled by the resulting steam; or, taking another form of the instrument which is often used, the water in the reservoir would of course also boil, thereby adding to the moisture in the air in the room, and would also soon be evaporated.

This firm was so anxious to have a psychrometer indicating to this temperature, that I determined to try some experiments to ascertain how far it was possible to comply with their desire. I therefore placed a pair of long-range thermometers, one with a dry bulb and the other with a bulb covered with muslin and continually kept wet by water led from a reservoir placed outside of the reach of the hot air blown past the bulb, in the stream of air from a heater delivering some 7,000 cub. ft. of air a minute at temperatures up to 248° F. Much to my surprise I found that the indications of the pair of thermometers were even at this temperature pratically correct, and most valuable observations were thus obtained. It was, for instance, probably the first time that 135° F. difference in the readings of the two thermometers had been observed, the air with 80 per cent. of moisture of the atmosphere at 50° having been so heated that at 28° it only contained 2 per cent. of moisture. It will be at once apparent how enormous the drying capacity of such a stream of air must be, and how avid it must be of moisture.

On placing a disk of thick cotton tissue in its passage, I found it, so to say, impossible to keep this cotton wet except by continuously spraying it with a very large quantity of water delivered from a jet under high pressure. Taking the atmosphere at 50° F., with 80 per cent. of moisture, the absorbing power of each cubic foot of air would be about 0·82 grain of water, but this same air after being thus treated, at its exit at 28° F., with only 2 per cent. of moisture would theoretically be capable of absorbing some 469·28 grains of moisture per cubic foot, and admitting in practice that only two-thirds of this amount was absorbed, it still leaves over 300 grains per cubic foot as the amount of water it is capable of removing. And this air being delivered at the rate of 7,000 cub. ft. per minute would seem to show a removing or drying capacity of 300 by 7,000 grains per minute (and as 7,000 grains are one pound) or 300 lb. of water per minute. Yet the consumption of fuel for obtaining this stream of air was only about 2 cwt. per hour.

This shows at once that there is some other factor to be considered, for I need not say that with some 3⅓ lb. of fuel per minute it is absolutely impossible to evaporate 300 lb. of water in the same time, but I have placed the matter in this way before you to make this factor more apparent, for it is only too often totally neglected in practice.

It is therefore easy to determine at any given moment, and in any drying room up to 250° F., and probably further, the hygrometric condition of the air, by the use of a pair of thermometers mounted as I have just described; and while avoiding, on the one hand, the too rapid renewal of the air, which would simply mean expelling so much warm air before it had done its work, it at once gives a means of avoiding, on the other hand, what is only too often the case—stewing the materials in an atmosphere so saturated with moisture that no drying can possibly take place, with all the attendant loss of time, money, quality, and color, of the materials, not to mention room space, rent, and other expenses. Had such a pair of thermometers been mounted in the drying rooms I have just mentioned, and their indications attended to, they would at once have shown the fault, and the absolute necessity of the renewal of the air, so that it should be impossible for it to condense on the body in the manner it did on any person entering the room. As I have already said, although the formula for ascertaining the percentage of moisture of the air by means of the readings of a pair of wet and dry bulb thermometers is rather complicated, or at least tedious to calculate, yet the results are easily tabulated, and then the result is obtained by the mere inspection of the table. Although tables are easily obtainable for temperatures up to about 100° F., yet I am not aware or able to learn of any being in existence for temperatures up to, say, 250° F.

From the interesting indications obtained in the experiments I have just described, I have been engaged in calculating a table reading up to 250° F. for differences in the readings of the two thermometers as high as 135° F., as such differences are obtainable. Readings taken even only every 9° F., within these limits, would appear to be all that is required for practical purposes, as one or two per cent. of moisture does not much affect the result, and it is also easy to interpolate roughly by guessing with sufficient accuracy. In this table there appear to be some 200 results necessary to complete it, yet to obtain them something like 400,000 figures are necessary, besides continual reference to tables of the elastic force of steam, etc., so that it will easily be apparent that its compilation is a work of patience. I regret that I have not yet been able to find sufficient leisure to complete it, although I have been at work on it for some months past, or I should have had much pleasure in placing it before you tonight.

To return now to the seemingly enormous evaporative or drying power of the heated air at 248° F., of which I was speaking in referring to these experiments, and what no doubt would at once appear to many its power of evaporating water at a fabulous rate. Of course nothing so wonderful is possible; for water, in order to pass from the liquid to the gaseous state, requires a large amount of heat, and some heat is also necessary to warm the goods up to the temperature of the drying room; besides there are all sorts of losses by radiation through the walls, floors, ceilings, etc., but more especially through the windows. There is also to be considered the dew point or temperature at which the heated air becomes saturated so that it cannot any longer maintain the water in suspension; and as the whole of this heat must be taken from the heated air, its temperature and moisture-absorbing capacity are thereby at once lowered.

It is not difficult to determine approximately how much air and how much heat is necessary for the evaporation of any given amount of water in drying at any given temperature, and also to examine the relative amount of heat expended in each of the various losses. To take an instance. Let us suppose it is necessary to evaporate every hour 220 lb. of water, the external temperature of the atmosphere being 50° F., and the temperature of the damp and cooled air at the exit from the room being 95° F. It will be necessary to send hourly some 12,940 lb. of dry air through the room, and the bulk or volume of this weight of air will therefore be about 172,348 cub. ft. Then suppose the external air to be saturated, which it seldom is, the average amount of saturation of the air here being probably about 80 per cent.; but it is of course advisable to consider the outer air under the worst possible conditions, so that the drying may be accomplished with certainty in all states of the weather, even if it is more rapid on fine, dry days. It will then be necessary to send the 172,348 cub. ft. of air into the drying room at a temperature of 175° F., and the heat will be expended in the following proportions: The air itself will absorb 4·75 calories, the steam contained in it 0·12 calorie, and the water vaporized 10·62 calories, total 15·49 calories. There will, therefore, be some 91,112 calorie to supply per hour, which shows a consumption in fuel, of good coke for instance, of about 40 lb. per hour. As to the efficiency of this application, these figures show at once that it is $\frac{10\cdot62}{15\cdot49}$ or 68 per cent.; that is to say, that out of the total 15·49 calories sent in, the 10·62 calories expended in vaporizing the water in the room represent the part of the total heat usefully employed. In reality the efficiency will be somewhat less, for a further amount of heat is necessary—that necessary to warm the substance to be dried from 50° to 95° F., and no allowance is made for radiation losses, etc.

In passing air in motion through a room it is of course impossible to make sure or to obtain that every particle of air will meet with a particle of water to absorb, but if the goods are carefully disposed so as to obtain the best contact possible with the air in motion, something like two-thirds of the theoretical amount of absorption may be obtained. And it is now apparent to you why the 7,000 cub. ft. of air a minute at 248° F. I mentioned in the experiments with the thermometers could not, in spite of their only containing 2 per cent. of moisture, evaporate the 300 lb. of water per minute I then spoke of, as the heat necessary for the evaporation of the water would have had to come from the air; to how great an extent you now see, for in the example I have just given you, the 172,348 cub. ft. per hour is 2,872 cub. ft. per minute, which, although heated to 175° F., can only evaporate about 220 lb. of water per hour, or say 3·5 lb. of water per minute.

I have not wished to weary you with figures, and have therefore summarized the results in the foregoing example, the more so that all these problems are much easier to deal with in cubic meters and Centigrade degrees, and are even then complex and tedious to work out. To show how far this is so, I give here the formula for determining the efficiency of a drying application, that is to say, the proportion of the heat actually expended in vaporizing the water to the total amount of heat expended, premising it with the indication that the ⅔ is the two-thirds of the theoretical duty which constitute good practice, and that p_t is the weight of steam in one kilogramme of dry air at $t°$ C., and that $p\theta$ is the weight of steam in the air at $\theta°$, $t°$ and $\theta°$ being respectively the temperatures of the outer air and of the air of the drying room at its exit:

$$\frac{\frac{2}{3}(p\theta - p_t)\,[606\cdot5 + 0\cdot305\,(\theta - t)]}{0\cdot2377\,(\theta - t) + 0\cdot475\,p_t\,(\theta - t) + \frac{2}{3}(p\theta - p_t)\,[606\cdot5 + 0\cdot305\,(\theta - t)]}$$

That it is sufficiently complex is at once apparent, and in Fahrenheit degrees, pounds, grains, cubic feet, etc., it is still more so, but as these are our current measures in England, I have used them in all other parts throughout this paper.

The applications, therefore, of air in motion to drying, both in chemical industries and in the allied trades, are so numerous that in the time and space at my disposal I can only call your attention to some of the most important. Beginning with those trades which are perhaps more strictly speaking users of chemicals than chemical industries, one of the first is that of the cotton, woolen, silk, flax, hemp, jute, and other textile manufacturing. In all of these trades at some period of the process of manufacture the goods have to be dried, and I have already shown how the process can be accelerated by using fans properly applied.

In the leather trade the use of air in motion is of peculiar value. It is, however, necessary to distinguish the great difference between the drying of oak-tanned and extract leather. The treatment which would dry the oak tanned perfectly would irretrievably injure and blacken the extract leather, which is much more delicate while still damp. And this leads me to call your attention to the extreme importance of recognizing a fact too often completely ignored, which is that a fan is not a machine like a grindstone or a sewing machine, which will do its work no matter where it may be placed. The fan, on the contrary, demands very careful thought in its installation, it being generally found that there is but one place in a room or machine where a fan can be placed to do good work, and that placed anywhere else it may be worse than useless. Some years back I remember a firm in the leather trade buying a fan and erecting it where it was easiest to drive, quite regardless of the effect it might have on their skins, but I believe simply from the fact that a neighboring competitor was getting excellent results from his fan, and they wished to compete with him at an equal advantage. About two days after the fan was erected (it was in the month of August) a very warm day was followed by a cold, rainy night, and I believe that night cost them several hundred pounds, for the whole of the goods in their loft, which was a very large one, were completely ruined, and they were then fully convinced of the necessity of erecting the fan "judgmatically," for on re-erecting it in another position and in another manner, where it should have been placed at first, it gave excellent results, and others were subsequently placed in other lofts. Glue and gelatin are materials most particularly subject to the state of the air brought into contact with them, and are among those substances which it is most important to dry with the least possible amount of heat; here, then, air in motion is of the greatest value. I will take the extreme instance of gelatin as combined with salts of silver as used for coating the photographic dry plates. These, accord-

ing to their formula of preparation, will not bear a temperature higher than 70° or 75° F., and in addition it is most important to dry them rapidly and without the slightest particle of dust falling on the damp surface. If left to themselves in a room in which the air is simply heated without being in motion, they seem to get surrounded by a film of damp air and take as much as twenty-four hours to dry. With air in motion in the room, properly warmed and applied, they dry easily in a half or a third of that time, or even less, without the slightest risk of their being damaged by a speck of dust. But if the air is at all overheated the emulsion will not set, or if it does, sooner or later, changes take place in the film, and the plates become unreliable or worthless. On the other hand, starch and goods containing starch appear to need a considerable amount of heat to dry them, and are not so easily dealt with by cool air. Products in which linseed and other oils are used also dry best with a certain amount of heat, but the value of plenty of air in motion is most plainly evident in those cases where the so-called drying is in reality the oxidation of the oils in or on the various articles. In the paper trades the drying is really of course mostly done by steam cylinders, but air in motion is decidedly useful for drying the machine. Taking the glazed papers, for instance, if there is any condensation above, every drop of water falling on the paper leaves its mark. Taking wall papers, simply printed or both printed and varnished, it is very often a very slow and tedious matter to dry them without air in motion, and the same applies to cardboard and other kindred products. A firm manufacturing a sort of brown paper papier mache, half or three-quarters of an inch in thickness, found the drying so slow that the manufacture of these goods, which are often very bulky, could not possibly have paid. With air in motion the drying became easy, such articles being easily dried in 12 to 15 hours, and the result was that the manufacture of these articles became remunerative. At the beginning of this paper I mentioned the difference of air in volume and air under pressure, and spoke of the small amount of pressure generally sufficient to overcome an apparently considerable resistance. I then gave one instance, that of a coal dust fire; malt drying supplies another. It would at first sight seem impossible to overcome the resistance of two floors of wet malt each 15 in. thick, without considerable pressure, but such is not the case, for it has long been proved that air in large volume and almost without pressure can be rapidly passed through it, thereby producing a most excellent and rapid drying. Hops are also easily dealt with in an almost similar manner. For bricks, tiles, pottery, porcelain, etc., the use of air in motion offers peculiar advantages, and even saggers and other large pieces are easily dried without risk of fracture, the waste heat for the stoves or ovens being used for the purpose of increasing the drying power of the atmosphere. Timber is also rapidly and efficiently seasoned, for no nearer approach to the effect of a summer wind can be produced. In cement works the drying of the slurry is accomplished much more rapidly, and almost any kind of fuel can be used in the kiln should its shape admit of this. In the chemical industries properly speaking fans have been applied with perfect success for drying gunpowder, smokeless powder, oxide of zinc, superphosphate of lime, white lead, sulphate of copper crystals, transparent soap, cellulose wood pulp, delicate dyes such as saffranin, etc., diatomite, kaolin, anthraquinone, guncotton, photographic films, etc. I cannot give a better instance of the value of air in motion in the chemical trades than the following: Some time back I had handed to me a lump of wet crystals of the consistency of thawing snow, and was told that although it had been lying on the top of a boiler for a fortnight it showed no signs of drying. I was warned not to exceed a temperature of 190° F. On placing it in a drying stove with air in motion at this temperature, after 48 hours' continuous running it still showed no sign of drying, and was practically in the same condition as on starting. The workman in charge got impatient with it and forced the heat. When at 200° F. the substance immediately melted, and he, not to spoil it, at once stopped the heat and sent air at about 60° F. through the stove instead. The material dried up at once. We subsequently found that this was the only manner to dry this product, and that it suffered no damage by this treatment. At a sewage works the residue of the filter presses is now completely dried without loss of the large amount of free ammonia it contains, at a cost of about 10s. per ton, and finds a ready sale at 25s., the only fault being that there is not more of the sludge to increase the profit. For evaporating liquids the use of air in motion offers one of the cheapest and most rapid methods of concentrating chemical solutions.

So far I have only spoken of the application of air in motion to one purpose, but it can often be applied to more than one. For instance, in a laundry the hot air exhausted from the ironing room can, after being warmed, be used for drying the linen, and after leaving the drying room it is still able to assist very materially in removing the steam in the wash house, which it dispels in a double manner, first, because this air, not being saturated, has still a capacity for absorbing steam, rendering it invisible and preventing condensation; and secondly, by driving it out of the laundry. In an installation erected some years back the whole of these various duties are most satisfactorily performed, and in addition the exhaust of the engine being passed through the steam coils used for heating the air of the ironing room before its entrance into the drying room, the additional power thus imparted to the engine is more than sufficient to run the fan, the proof of this being that the engine runs more easily with the fan than without it, so that in addition to the air in motion not costing anything, there is also a margin of power obtained for nothing. I will mention one more instance. It is well worthy of consideration if what is objectionable in one line of business is not valuable in another. Some time back I was called into a large electric station to remove the heat from the engine and dynamo room, and the best place for doing this adjoined a neighbor's property. Upon calling upon him I found he was a timber merchant, and so the matter was easily dealt with as follows: The fan was erected to remove the hot air from the engine room, and he erected a drying room for his timber, and each paid one-half of the cost of running the fan, the value of co-operation between separate firms being thus fully demonstrated.

So far I have only dealt with the question of putting air in motion by mechanical means, especially by the use of fans, and this leads me to say a few words on the subject of so-called "automatic" ventilation. Many so-called automatic appliances have been invented for the purpose of removing the air out of a building, but if they are correctly investigated they will generally be found, I might say always, to be worse than useless. The mere word automatic immediately suggests that the air can put itself in motion alone and unaided, and I am afraid that, notwithstanding the advance of science, perpetual motion is likely to remain one of the impossibilities. Many of these appliances aim at more still, for they expect not only that the air shall put itself in motion, but do work, that is to say, move something else on its way. It can be proved, and is in fact almost obvious, that the best way to take advantage of any natural tendency of air to displace itself is to leave it to escape through a perfectly free opening, for anything placed in the opening can but impede the motion of the air in the same way that an obstruction impedes the flow of water, or that a turnstile or barrier retards and impedes the exit of a crowd of people. Some of these appliances are put in motion by the external motion of the atmosphere, all forgetful of the facts that if there were any motion in the atmosphere the wind would naturally displace air through the building, and that if there is none it is the very time when they are most wanted that they are ineffective and therefore worse than useless. There are also, of course, other means of imparting motion to the air, such as gas jets burning underneath an opening, or applying a steam jet to it on the exhauster principle, but on duly valuing their efficiency it will be found that had the same amount of gas or steam been used in an engine driving a fan, a very much higher displacement of air with consequent economy would have resulted; still, they are so far correct that they put the air in motion positively, by supplying it with motive power, and help it to move without expecting it to produce its own motive power. The same applies to water, for although of course a water spray or jet will put air in motion, the same amount of water will give a greater displacement of air if utilized in a motor driving a fan. Electricity is also one of the most convenient motive forces possible for driving, as where in many cases it would be almost impossible to apply a gas, steam, or water motor, or to transmit power by means of pulleys and a rope or belt, a pair of wires and a motor can be erected without any difficulty. There is also another matter to consider in putting air in motion, and that is the cost of the driving power. Many buy fans because they are a few pounds or shillings cheaper than others, and think that they have made a good bargain and saved money, without the slight thought that in moving such a mobile and compressible matter as air there are all sorts of considerations, such as the slip of the air in the fan, and that the cost of the fan is a small matter compared with the cost of the power expended in driving it. For instance, a fan costs £25 and takes 2½ h. p. to drive it with a duty of 30,000 cubic ft. of air per minute. Another fan costs say £20, displaces the same amount of air in the same time, but takes 3 h. p. to drive it. As every h. p. costs from £10 to £40 per annum, according to the size of the engine producing it, whether it is one of 40 h. p. or 4 h. p., say an average of £25 per annum, then the additional half h. p. costing £12 10s. being added to the cost of the fan, makes the relative expense even at the end of the first year £87 10s. for the fan which originally cost the most money, and £95 for the cheaper fan, which will in addition be wasting continually £12 10s. per annum in every successive year, even if it can move the volume of air or do the work. If I emphasize this by saying that I have tested fans of the same dimensions, where one took not only 3 h. p., but nearly 12 h. p. to drive it, instead of the 2½ of which I have just spoken, it will be at once be seen that the cost of the "cheaper" fan at the end of the first year would amount to £300 as against the cost up to the same period of its "dearer" rival of £87 10s., and all to try to save £5 in tangible cash. There is also another point here to which I wish to draw your attention, which is, that if you can displace 15,000 cubic feet of air per minute for 1 h. p. you are doing excellent work, and that fans professing to do nearly this amount of work per man power, or say 150,000 cubic ft. per h. p., will, when you come to test them scientifically, not do what you may have expected of them. And while speaking of the amount of motive power necessary to drive a fan, and the subject of cost and economy, I wish again to recall to your attention what I said in beginning, about the great difference between pressure and volume. It always costs much more to move the same volume of air at a high velocity than at a low one. One-half h. p. expended on a 36 in. fan costing say £17 will move 14,000 cubic ft. of air per minute; 1¼ h. p. expended on a 60 in. fan costing £37 will move 21,000 cubic ft. of air per minute. At the end of the first year, still taking the h. p. at £25 per annum, the 36 in. fan will have cost £54 10s., and the 60 in. fan will have cost £74 10s. With the smaller fan each thousand cubic ft. of air per minute will have cost £3 17s. 10d., with the larger one the thousand feet of air will have cost £3 16s. 9d., and every following year half as much air again will be displaced without extra cost, and therefore with corresponding economy. Therefore it is at once apparent that it is generally a false economy to employ a small fan driven at a high speed; on the contrary (except for special purposes where some amount of pressure is necessary) or to drive any faster than is needful for the purpose to be attained. This is due to the fact that air at double the pressure takes twice the power to move it, and more, and at three times the pressure it takes three times the power, and more, and so on.

There is one point to which I should have been glad to refer in this paper, but, although many of you will doubtless have expected me to say something on the subject, I have carefully refrained from so doing, and this is, how to apply the fan to put the air in motion. As I have already said, a fan is not a machine like a grindstone or a sewing machine, that will do useful work no matter where it may be placed, and as it is usually a case of applying a fan to existing buildings, and as except in special cases—malt kilns, for instance—no two buildings are alike, and each building almost certainly differs from any other building, therefore no two applications except in these special cases are exactly alike. On this point it is most desirable therefore that special experience should be brought to bear; and those requiring the fan on the one hand, knowing the result they wish to obtain, and those having the practical experience of air in motion, on the other hand, will always obtain the best result by discussing the application together and thus obtain a successful application which otherwise might, more likely than not, result in disastrous failure. This is doubly undesirable, for not only is the whole matter given up in disgust, to say nothing of the possible loss, but it also discredits the use of air in motion, although its use might have been, not only probably but almost certainly, of the greatest service. And in nearly every case it will also be found that to secure the most efficient application, it is not sufficient to merely consider the room or building in which a result is desired, but all the surroundings, even those of the neighbors.

And to conclude, I will only add that one firm alone, having gone on buying fans until they have now over a hundred running in their works, capable of displacing 3,000,000 cubic feet of air per minute, or 180,000,000 cubic feet of air per hour, having probably cost over 3,000*l*. to erect and apply, taking probably over 250 h. p. to drive them, at a yearly cost of perhaps some 6,000*l*., seem to have found that there is some advantage to be derived from the application of air in motion.

DISCUSSION.

The chairman said this was a most interesting communication, which showed among other things that there was much ignorance among manufacturers and others as to the real problem of drying. He was sorry to say that he had known personally of drying rooms very much like those Mr. Watel had described, where apparently the object was to make everything as hot as possible and take care that no water was lost in the process. The experience of many present would no doubt furnish cases of a similar character. Some years ago he tried to heat air before it went into a drying room, but the difficulty met with was that the iron pipes used for conveying the hot air were rapidly burnt out, and the method had to be given up. Perhaps Mr. Watel would be able to tell them how to avoid that difficulty.

Mr. W. Crowder asked if the fan on the table was one which could be recommended for use with a Lancashire boiler without a chimney, and would it also be applicable to a reverberatory furnace?

Mr. Watel said it would drive a Lancashire boiler very well, and would be suitable for some types of furnaces, but where there was a very heavy resistance it would be perfectly useless. It was quite opposite in its effects to such machines as the Roots blower or a Beale exhauster. He had seen a blast fan which gave a very high pressure with a small volume; perhaps 54 inches of water gauge, but with 40 or 50 h. p.; it could not fill more than a 1¼ in. tube. This fan was exactly the reverse; it moved a large quantity of air at low pressure. With regard to its use with a reverberatory furnace, it would depend greatly on the construction of the furnace itself, but for a Lancashire boiler, where one had simply to send the air under the fire bars, one could send any amount of air at anything under 1 in. pressure.

Mr. Crowder said that from 7 lb. to 9 lb. of water could be evaporated in an ordinary steam boiler for 1 lb. of coal. What would be the corresponding effect in driving off water from any material such as had been spoken of by the use of this machine? Could it be done to the same extent?

Mr. Watel said as a rule to a considerably less extent, because there were a great many conditions which came in. In the first place, a boiler once warmed was always the same, but in drying goods the goods themselves had to be warmed up to the temperature of the drying room, which necessitated a certain amount of waste heat. Again, all the water within a boiler was in a certain space and could only escape by vaporization through the steam pipe, but if air were sent through a drying room, it was not certain that every particle of hot air would find a particle of water to absorb, and, therefore, there was heat wasted in that way; but with the apparatus well devised and the goods properly arranged there was no difficulty in getting between 60 and 70 per cent. of efficiency.

Mr. R. J. Friswell said many years ago he made use of the wet and dry bulb thermometer for the purpose of ascertaining whether a drying room was acting properly, but he was very much troubled with the growth of the mycelium of a fungus which attacked the wick conveying the water to the bulb, and in a short time destroyed its efficiency and rendered it utterly repellent of water. He, therefore, found it necessary to use distilled water, and sterilize it with carbolic acid in order to make it act efficiently. He also discovered that one of the very best tests of the drying room was the condensing power of the human skin. Its normal temperature was somewhere about 97°, and if on going into a drying room one felt that cold perspiration to which Mr. Watel had referred suddenly settling on the skin, one might be perfectly certain the room was not acting efficiently, that there was not sufficient air passing through it. This was a test which any one could apply; and by having proper dampers and regulating the rate at which the current of air was passing through, the conditions might be altered.

Mr. B. Blount though the efficacy of forcing a draught under boilers might be considerably overrated. The use of an excess of oxygen should not be the aim of the engineer who sought to get the utmost efficiency out of his coal. He had analyzed the gases issuing from the waste pipe when this forced draught was on, and he knew very well that although the black smoke which disfigured the end of the chimney when the draught was defective soon ceased when a forced draught was put on, yet as a matter of fact there was a much larger excess of air in the exit gas in the boiler than before, and all that air had to be warmed up, which meant coal, and was not economical. They should therefore be a little chary of suppressing mere smoke by such means.

Mr. Watel said tables were prepared for use with the thermometers which showed at once the percentage of moisture due to any difference between the two thermo-

meters, and gave at once the actual percentage of moisture in the air. Another table gave the number of grains of vapor in the cubic foot when saturated, and if the air had 80 per cent. moisture one knew how much it could still absorb. He quite agreed with what had been said as to the value of distilled water for use with the thermometer; in fact, it ought always to be used, otherwise in many cases a sort of scaly deposit formed, probably of salts of lime and other matters, on the muslin, which very seriously impeded evaporation. With regard to forced draught, he quite agreed that it might be excessive. He had seen forced draught in a closed stokehole when under 2 in. of water gauge and more, and knew that not only must there be a great deal of air going up the chimney, but a great deal of coal too. That was why he expressed the opinion that something like 500,000 to 600,000 cub. ft. of air per ton of coal was about the right amount, and should not be exceeded.

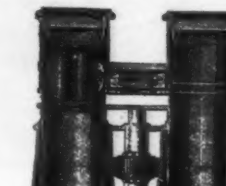
THE OPERA GLASS CAMERA.

THE opera glass form has long been recognized as a desirable one for the hand camera, and although, dur-

ing the past twenty years, numerous patterns have been introduced, this type of instrument has not come into very extended use. It is probable, however, that the reason of this is the unsatisfactory way in which the idea has generally been carried out; but the reproach of unsatisfactory execution cannot be urged against the newest instrument of this type—the "photoscope" of Mr. W. Sanders, of Liverpool, who has constructed an instrument which, for completeness, excellence of workmanship, and well thought out design, certainly goes far beyond previous efforts.

The framework and focusing device of the instrument is that of an ordinary opera or field, and to make it complete for independent use as a binocular telescope, the necessary lenses are supplied. When these are removed, and the photographic fittings are set in the now vacant places, the instrument becomes a camera, with a focusing and locating finder, to be used by looking into the large end, as shown in the first cut; while the second cut is a sectional drawing showing the internal arrangements.

The two objectives seen in the small ends are twin lenses, and that to the left casts its image on the film of a small metal roller slide, while the finder on the right is so arranged that the aerial image may be focused, or it may be projected upon a ground glass



surface, this latter course being desirable when the person using the instrument cannot otherwise control the accommodating property of the eye.

We have seen very excellent examples of work done with Mr. Sanders' photoscope, and we believe the instrument will be of great value to those who wish to do the best and most accurately found and focused work with an exceptionally small instrument.

The Focusing Device.—In the barrel shown on the right, we have one of the twin objectives, the ground glass screen, and a telescopic eye-piece, and an ordinary focusing magnifier. There is also an arrangement in the shape of an eccentric which, by rotation, lowers or raises the ground glass and presents to the eye either the telescopic eye-piece or the magnifier, at the will of the operator, and this change can be made without removing the instrument from the eyes. The operator is enabled by this system to select, with unerring aim, what to take and what to exclude right up to the last instant before releasing the shutter. The varying light is said to be much better judged through the telescope than with the naked eye or on the ground glass.

The Shutter is of the stopcock construction, as improved by the late Mr. Wm. Bedford on the original device of Professor Piazzi Smyth, that was used by him so successfully over a quarter of a century ago. It is a light ball diametrically pierced, the width of the opening being a little more than half its diameter, and the ball requires but a half turn to complete an exposure. The stopcock shutter is the most compact and satisfactory shutter for a minute apparatus, all movements being balanced and friction reduced to a minimum. The mechanism by which the ball is moved is inclosed in a small box fixed between the two barrels of the instrument, and is hidden from sight. The shutter is worked by a slight side pressure on a small pin which protrudes a quarter of an inch through the top of this box. When the pin is perpendicular the shutter is full open—that is, the diametrical opening in the ball is horizontally positioned—and when the pin is at a certain inclination, the opening in the ball is perpendicularly positioned, the shutter being then closed. The shortest exposure, without the aid of the instantaneous movement, is about one-fifth of a second, and it will be easily understood that the slower the movement of the pin the longer will be the exposure.

The Instantaneous Action.—In case an exceptionally rapid exposure is required, the shutter is provided with an automatic movement brought about by the release of a spring with a hair trigger, a slight pressure of the thumb being all that is necessary to complete the most rapid exposure. The spring also acts as a check to the shutter when the instrument is not in use.

The Roll Holder is made of metal, and is of improved construction, it being worked from the center. The power is delivered to a large cog wheel which drives, at right angles, another half its size, the smaller being attached to the feed roller, thus enabling sufficient material to be wound off in half the usual time. The requisite quantity of film is measured off by a circular disk of large dimensions, which registers each exposure, and is rotated by a free roller over which the film travels, so that a glance at the disk immediately shows the number of exposures wound off. Negatives may also be taken on plates when required.

The Lenses.—These are single achromatic, and capable of covering plates four or five times the size of that which the camera can accommodate, so that the views are narrow angle, or, rather, photo-telescopic.

Being an opera, field, or marine glass, independent of its photographic functions, and that form being still preserved when it is converted into a photographic apparatus, it can be used where no other camera is available. Moreover, the focusing being done in the manner of all binoculars, moving objects may be followed, and kept in view through the glass until the desired moment, when they can be secured.—*Photographic Work.*

STRUCTURES OF BLOWN GLASS BRICK.

MR. FALCONNIER, an architect of Lyons, has devised a new product especially for building purposes, and that is bricks of glass filled with air. It was on the occasion of the construction of a veranda that the idea occurred to him to replace the thin walls of iron and glass, which appeared to him flimsy, by something stronger and thicker, and it was thus that the blown glass brick was conceived.

These bricks are nothing more than bottles, blown like ordinary bottles, but to which certain forms (cubical, hexagonal, etc.) are given in order to permit of assembling them.

It will be understood that, thus formed, these bricks fulfill the role of double windows and constitute an excellent preservative against cold as well as against heat. They are, moreover, very good insulators of humidity and noise. From an æsthetical standpoint, they lend themselves very well to the decoration of buildings either by their form or their color.

The great difficulty that the inventor of these bricks had to conquer was that of making them adhere to each other. They are provided at the circumference with a groove in which is placed a substance that is to form a key in solidifying. Such a substance is quite difficult to find.

Mr. Falconnier tried plaster of Paris in the first place; but this material, which, like lime mortar or slow-setting cement, can be advantageously employed in certain cases, is not adapted for roofings because it is permeable to water. Quick-setting cement, upon expanding, causes a breakage. Finally, Mr. Falconnier thinks that he has found what he wants, especially for his roofings, in a bituminous substance with a base of asphalt. It is, it is true, difficult to lay, but up to the present it has given good results.

It was not without trouble either that, owing to the routine that prevails in certain manufactures, Mr. Falconnier was able to get glass works to deliver him bricks with the orifice closed while hot. Originally the orifice remained open like that of bottles, so they came to hand all dirty in the interior and it took a considerable time to clean them. A Swiss house was the first to effect the closing of the bottle at the moment of blowing it. The operation is very simple, and is performed by a boy while the glass is still at a red heat.

On cooling, the air inclosed in the brick produces a certain vacuum and the pressure to which the sides are submitted by this fact is a guarantee of the strength of the piece.

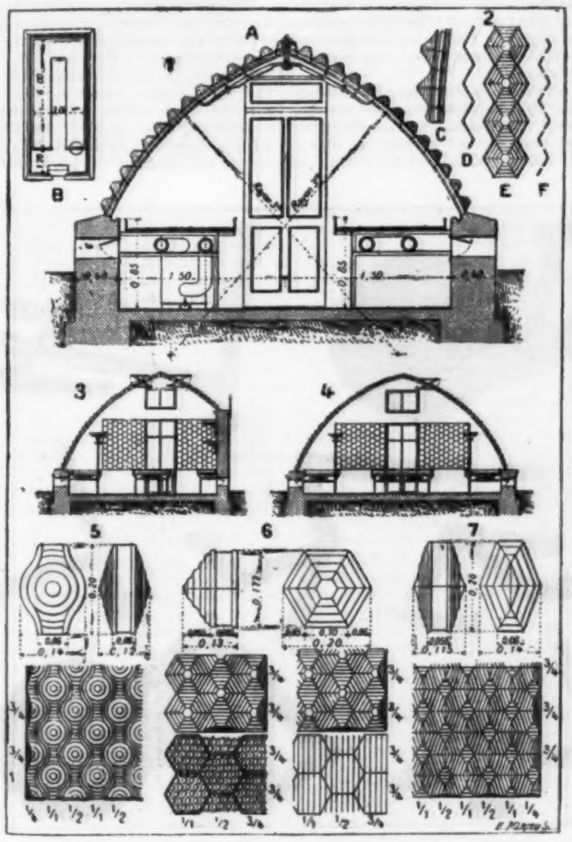
In the interesting materials whose cause he warmly pleads, Mr. Falconnier sees an incalculable number of applications. Owing to their transparency, they permit of giving light in rooms without the necessity of establishing windows. Recourse may be had to them, too, when the legal distance is opposed to the piercing of walls. They will be equally appreciated in countries where a duty exists upon doors and windows.

Walls of glass bricks can be very easily kept in the most perfect state of cleanliness. They will be able to replace marble in meat markets, and be utilized for the construction of hospitals, bath halls, etc. Their property of being bad conductors of heat will recommend the use of these materials for the walls of frigorific establishments and for hothouses. Some comparative experiments made at Lyons with registering thermometers have shown that in hothouses constructed of blown glass bricks the temperature remains much more constant than in hothouses of ordinary construction.

These experiments, which began in 1891, were made at the Tete d'Or Park, simultaneously and comparatively, in a hothouse with ordinary glazing and straw mats and in a hothouse of Falconnier bricks without straw mats, the structures being heated by the same thermosiphon.

Thus, one of the first applications of the Falconnier brick will be the construction of hothouses. These latter, says the inventor, are made without iron, cost the same as ordinary hothouses, and, besides their advantages as regards a saving in fuel and material, have the advantage of resisting hail.

Upon the whole, Mr. Falconnier is on a fair road to the solution of an interesting problem. The ingenious



STRUCTURES OF GLASS BRICK.

1. Hothouse 3 meters in width with suspension upon the axis: A, section; B, plan. 2. Assembling of the bricks in vaults: C, side view; E, front view; D, F, use of hoop iron. 3. Lean-to hothouse 4½ meters in width. 4. Large hothouse of 6 meters. 5, 6, 7. Three types of glass bricks.

architect, in studying the principle of the glass house, has found a means of employing glass for certain special constructions and of utilizing it with advantage in multiple applications.—*La Nature.*

TCHEBICHEF'S JOINTED RODS.

MECHANISMS composed of jointed rods present in practice a very particular interest because of their advantage as regards saving in the loss of work due to friction. That is why we have thought it of interest to make known to our readers seven models of this kind of apparatus. They have been on exhibition for a short time past at the National Conservatory of Arts and Trades, and present the application to a solution of seven different kinematic problems. These systems are due to the Russian mathematician Tchebichef. They are formed essentially of three rods giving a symmetrical motion around an axis.

Figs. 1 to 7 represent the seven systems. Fig. 1 shows an apparatus in which the circular motion of the crank, C B, is converted into a rotary motion of the wheel around the axis, D, without a dead center. Fig. 2 represents the system in which the circular motion produces the motion of the lever, D, which passes rapidly from one of its extreme positions to the other. In the system 3, the lever, D, stops for some time in the center of one of its travels. Fig. 4 represents a system in which the circular motion of the crank, B C, is converted into a rapid return motion of the point, D, but slightly different from a rectilinear motion.

In Fig. 5 is shown a system in which the lever, D, makes two complete oscillations while the crank, B C, is making but one revolution. In the system represented in Fig. 6 the lever, D, receives an abrupt motion. As for the system shown in Fig. 7, that produces a transformation of the circular motion of the wheel, O, with this remarkable peculiarity: while the crank, B C, is making one revolution, the wheel, O, revolves from two to four times, according to the direction of its rotation. The dimensions of the parts of this latter system are the same as those of Fig. 1. There is no difference except in the position on the wheel, O, of the axis, at which ends one of the rods.

In order to show the advantage that may be derived from these mechanisms in practice, we may remark that in sewing machines it is important that the needle shall stop for a short time in the center of one of its travels. This result can be obtained by the aid of the mechanism 3 without the help of the eccentric. So too there are cases in which it is important to cause a wheel to revolve from a distance without the help of belts or gearings.

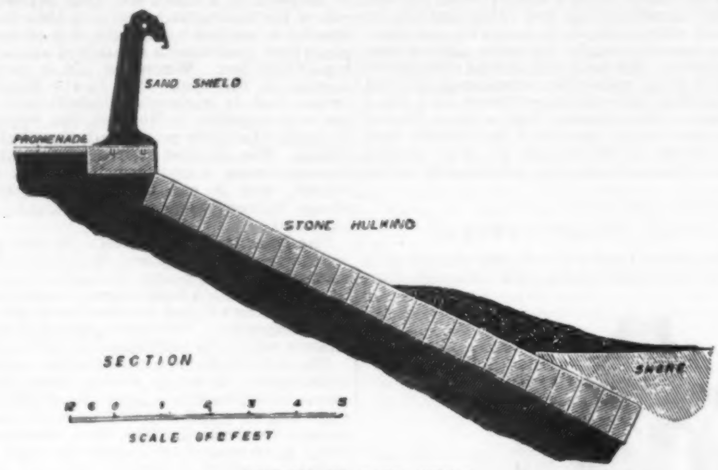
Then mechanism 1 can be usefully employed. The velocipede for ladies at the Chicago Exposition, and which we illustrate in Fig. 8, is an example of such a case.

The abrupt motion of the lever furnished by system 6 serves to throw grain to a notable distance in the separating machine exhibited at Chicago, and which is represented in Fig. 9.

Finally, let us remark that a proper combination of the mechanisms just spoken of gives a conversion of the circular motion of the crank into an alternating motion of the paddles in the boat shown in Fig. 10, which was constructed at St. Petersburg, where experiments are making on propellers.—*La Nature.*

A SAND SHIELD.

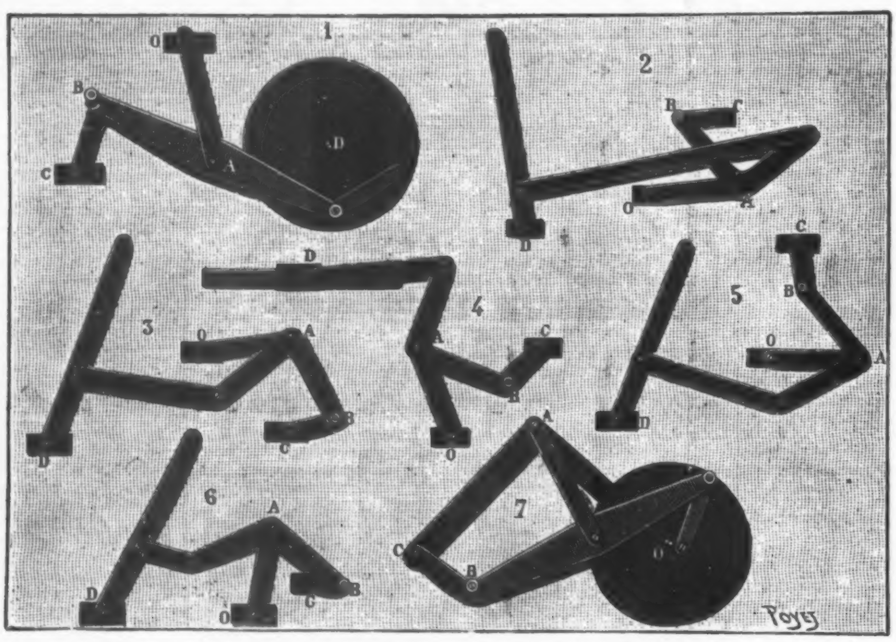
DURING strong winds the drifting sand from the shore has been a great annoyance to visitors walking on the promenade at St. Annes-on-the-Sea, as well as costing a considerable sum yearly to remove.



SECTION OF SAND SHIELD

Herewith we publish from the *Engineer* a sectional view of an arrangement recently erected by Mr. J. Ireland, Blackpool, with the object of stopping the nuisance, and called locally a "sand shield." It consists of a cast iron coping formed with plates 4 ft. long by 3 ft. high, with flanges at each end; these flanges are bolted to cast iron standards standing between them, the standards being secured at the base to the stone coping by jagged bolts. The plates are continued over on the shore side, so as to form an overhang 12 in. deep, the whole length of the coping.

The drifting sand is carried along within a few



FIGS. 1-7.—TCHEBICHEF'S JOINTED RODS.

FIG. 8.—TCHEBICHEF'S LADY'S VELOCIPEDE.

FIG. 10.—TCHEBICHEF'S BOAT WITH JOINTED RODS.

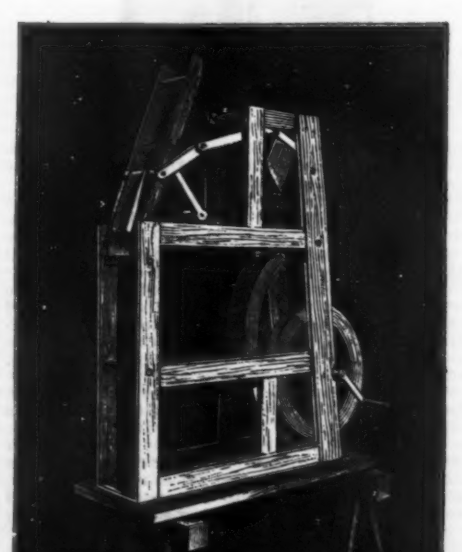
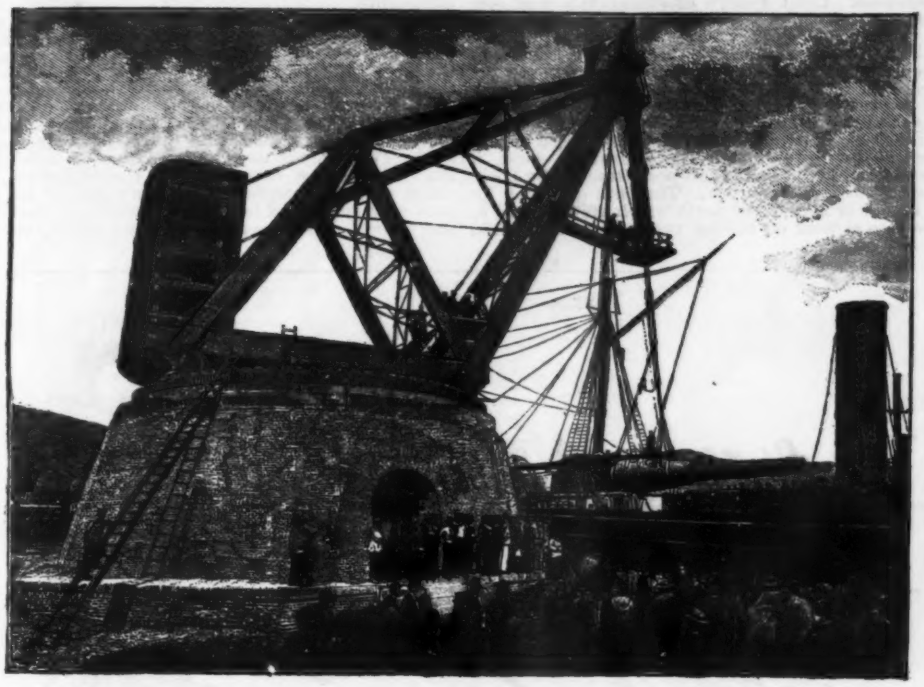


FIG. 9.—TCHEBICHEF'S GRAIN SEPARATOR.

inches of the shore by the lowest stratum of the wind. This lowest stratum coming under the overhanging part of the coping—which forms a *cul de sac*—forms a cushion of air with a more or less rebound; the stronger the wind blows the greater the rebound, the drifting sand coming along the shore in front of the coping, as it approaches gradually slackens speed, until reaching the rebounding cushion of air, it stops, and so accumulates, sometimes nearer the coping and other times further off, according to the pressure or strength of the wind. The experimental length has, we are informed, proved entirely successful; one can stand during a gale of wind and look over the coping without any sand blowing in the face, while on the other part of the promenade the eyes could not be opened. The arrangement at St. Annes is only suitable where the tide does not reach the hulking in front of the promenade; but negotiations are in progress with the corporation at Blackpool to put down an experimental length, which will act as a sea wall, as well as to stop the drifting sand.



AN ITALIAN HYDRAULIC CRANE.

THE NEW CRUISER ALGER.

The Alger, which we represent herewith, is undoubtedly one of the most successful types of the kind of warships known as first class battery cruisers.

It was constructed at the state yards of Cherbourg in 1889. It is 344 ft. in length, 46 in breadth, and draws 20 ft. of water at the stern. It displaces 4,122 tons and its engine is capable of developing 8,254 effective horse power in giving it a speed that has reached 19·62 knots.

The Alger is constructed entirely of steel. Its engines are from the well known Creusot works, and its boilers, 24 in number, are of the Belleville system. The whole has been very happily executed, since in certain trials the consumption of coal was but 2 1/4 lb. per horse and per hour instead of the 2 6/10 lb. mentioned in the contract. As the bunkers, moreover, are capable of carrying 860 tons of coal, the cruiser's radius of action is most extensive.

The Alger has no other defensive armor than a protected deck of 3·6 inches. It is armed with four 6·5 inch guns, six 4·5 inch, and ten others of small caliber. All this artillery is rapid fire. Ten revolving guns and four torpedo tubes complete the offensive means of the ship.

The military masts are of riveted iron plate and carry no sail.

The Alger presents a very peculiar aspect on account of its vertical sides and the arrangement fore and aft for facilitating firing aft and ahead.

The vessel carries a crew of 325 men commanded by Captain Jaureguibery. It is at present attached to the Mediterranean squadron, division of the Levant.—*L'Illustration.*

THE HYDRAULIC CRANE AT THE ARSENAL OF SPEZIA (ITALY).

The crane shown in the accompanying illustration was built for the Italian government, and was erected in Spezia for the special purpose of lifting heavy guns in and out of men-of-war.

The crane has a capacity of 160 tons, and can be used for transferring the heaviest guns now constructed.

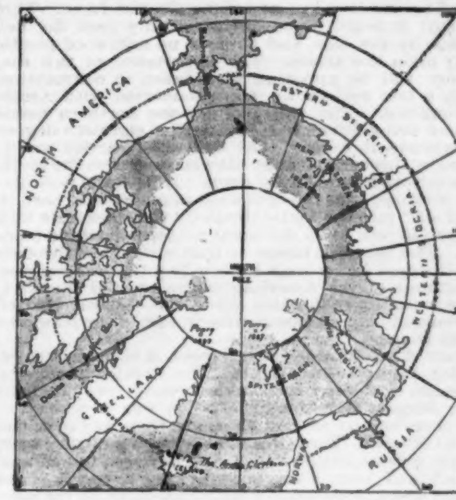
The crane is operated by water power. The water pressure raises and lowers the load and turns the supporting carriage to the proper place.

The box shown to the left of the illustration contains ballast to counterbalance the load and lifting device.—*From Prometheus.*

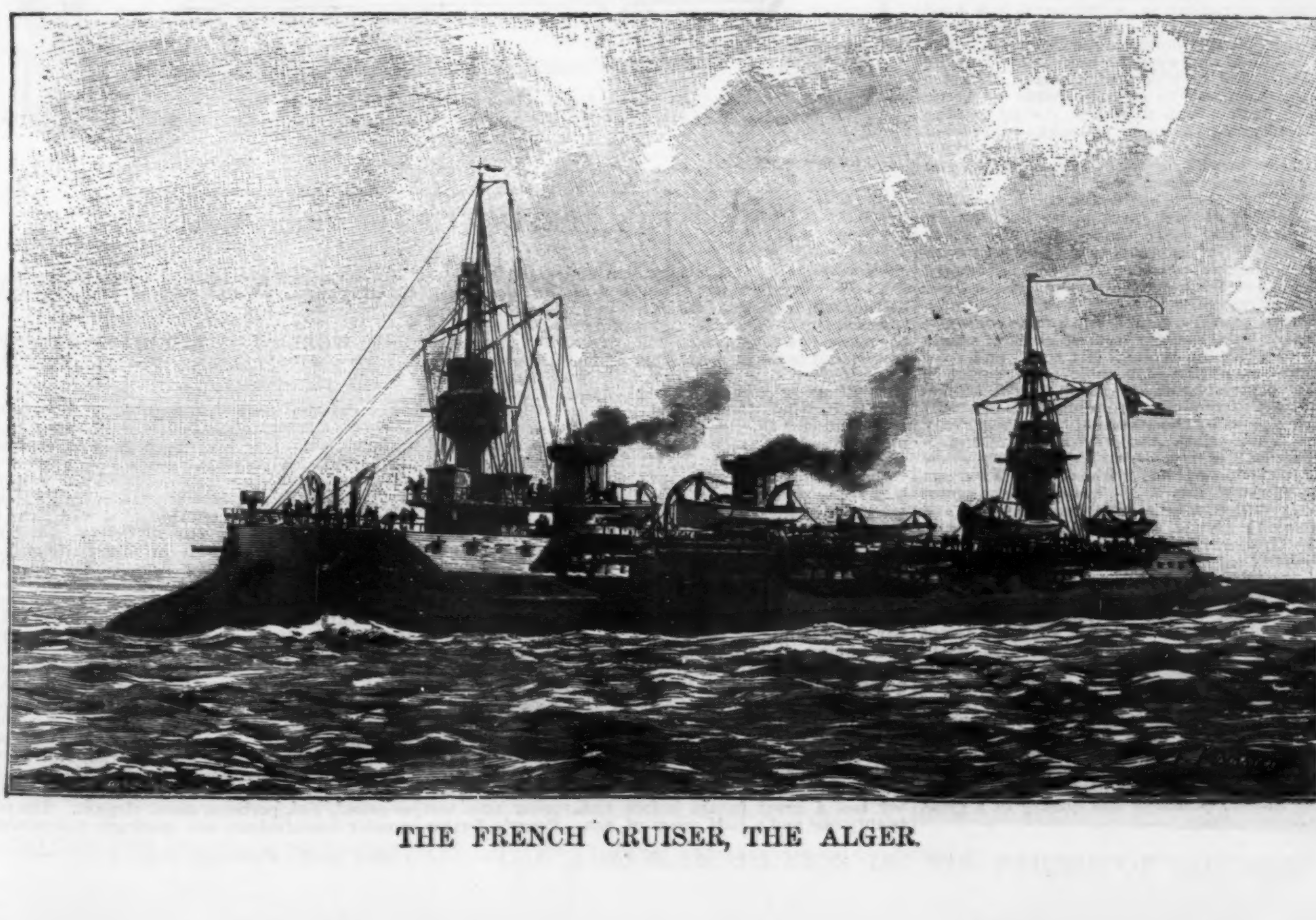
DR. NANSEN'S NEW POLAR EXPEDITION.

By Richard Beynon, F.R.G.S.

Dr. Fridtjof Nansen, in all his public utterances on the subject, has displayed as much confidence in the existence of a current which shall carry his projected expedition across the inner polar circle as Columbus did before the University of Salamanca with regard to reaching the Indies by sailing due west. The great Genoese navigator, sound as his reasoning was, failed to reach the Indies; but his memorable voyage in 1492 led to the discovery of a new world. The Nansen expedition may not succeed in getting near the Pole itself, but it is quite possible that something may be achieved which will at least narrow the polar problem. The close of the nineteenth century has witnessed the complete solution of that ancient geographical problem—the ultimate source of the Nile; and there is no reason to suppose it to be beyond the bounds of possibility that the primary mystery of the North Pole may be unraveled by some adventurous spirit before the next century dawns. There is an area of over two millions of square miles round the Pole which is virgin ground for the explorer; and it is not to be expected that all will be revealed to the first man who reaches the vanishing point of east and west. Yet just as Columbus' discovery of one of the Bahama Islands led to other discoveries which have been unparalleled in the history of the world, so may the discovery of a way by which the neighborhood of the North Pole can be reached lead to discoveries of great scientific importance.



This hardy Norseman's project is a new departure in Arctic exploration. He proposes to pass through the inner polar circles by the assistance of an ocean current which is conjectured to flow there, and thus to avoid many of those natural obstacles which have proved insurmountable in all previous attempts to



THE FRENCH CRUISER, THE ALGER.

reach the North Pole. To go with the stream is a maxim of worldly wisdom, and if the current in question really exists it is obviously wise on the part of the scientific explorer thus to turn it to account. At any rate, Dr. Nansen assumes its existence as a working hypothesis, and having the courage of his convictions, means to put the matter to a practical test. The theory of a great watershed in Central Africa was reasoned out by the late Sir Roderick Murchison before Dr. Livingstone proved the fact of its existence in the very region that had been indicated. The intellectual prescience which led to the existence of the planet Neptune being brought to our knowledge is another case of the kind. At present it is only possible to discuss the main reasons advanced in favor of a polar current which may be taken advantage of in order to reach perhaps the Pole itself.

In the course of explorations round Spitzbergen in 1889, Dr. Kukenthal discovered a new and apparently important current flowing through the whole length of the Olga Strait from north to south. It was observed everywhere, and at all times, from Northeast Land to the Rye Yse and King Charles Land. This current appears to be disturbed only near the flat coasts by the tide, and it casts up driftwood plentifully upon the shores. The importance of this discovery will be apparent when taken in conjunction with a few well-known facts connected with Arctic exploration. The tree limit of the northern hemisphere being altogether outside the eightieth degree of latitude, it follows that driftwood carried southward by this current must have entered from the south at some other part of the circle. It is quite possible, for instance, that the driftwood in question is part of that sent into the Arctic Ocean by the Mackenzie and Yukon Rivers, or by the great rivers of Eastern Siberia. The meridian nether to that which runs through Spitzbergen passes near Barrow Point, at the extreme northwest of the American continent, and the meridian nether to that which skirts the eastern coast of Greenland passes through Siberia east of the New Siberian Islands.

Now, a remarkable thing happened between 1881-84 which gives point to all this. The ill-fated Jeannette expedition entered the Arctic Ocean by way of Behring Straits, and when the vessel was wrecked the members of the expedition made their way over the ice to Siberia. Three years after the Jeannette went down, several articles which had belonged to her, and which had been abandoned by the crew at the time of the wreck, were found near Julianshaab, on the west coast of Greenland, having been carried thither on an ice-floe. The question arises, What chance, or what unknown current, carried these relics of the Jeannette from one side of the earth to the other within the short period of three years? Clearly they must have come by a comparatively direct route. Besides, in 1886, there were bows picked up off the coast of Greenland which were identified as those used by the Esquimaux in the vicinity of Behring Straits. It will be remembered, too, that Parry, in 1827, made but little progress with sledges on the ice-pack north of Spitzbergen by reason of the ice-field moving southward almost as fast as his expedition could make its way northward. Taking things like these into account, Dr. Nansen conceives that a means of crossing the polar apex may be found, and he is organizing the expedition which starts next summer in the deliberate hope of realizing the conception.

His intention is to make first for the mouth of the Lena, one of the greatest rivers of Siberia. That river pours a vast volume of warm fresh water into the Arctic Ocean, which, being so much lighter than the colder salt water, sets up a current flowing—as Dr. Nansen contends there is evidence to prove—in the direction he desires to go. He calculates upon getting into the ice north of the New Siberian Islands, and then, trusting to the drift of the current, allow his vessel to go with the ice-field. This he expects will take him on toward, and past, the North Pole, and ultimately bring him into the North Greenland Sea. Under the most favorable circumstances, a journey of this kind would occupy at least two years, but the expedition will be provisioned and outfitted for five years. The adventure is a bold one, even for a descendant of the Vikings. The vessel in which, with a crew of twelve men, Dr. Nansen means to face the perils of Arctic voyaging has been designed with a special view to "take the ice," as well as to withstand the buffets of hyperborean seas. In appearance it is not unlike a Scotch "buckie boat," but it is carvel built, and rigged as a three-masted schooner.

With all this, however, a sojourn in the highest latitudes for possibly several years is no light undertaking, although not quite unprecedented. Forty years ago, when Arctic equipments were by no means so complete as they are nowadays, Captain (afterward Admiral) Collinson, with the Enterprise, passed three consecutive winters in the ice north of Behring Straits, and would have passed a fourth but for the coals giving out. After a total absence from England of nearly five years and a half, he brought his vessel and crew home in sound condition—a notable achievement in itself. What experience and forethought can accomplish in the way of rendering high latitudes bearable is admirably shown by the record of the recent Peary expedition. They passed the winter at McCormick Bay (77° 43' N. lat.) in perfect comfort, and the whole object of the expedition was achieved without a single mishap, save the loss of the meteorologist under circumstances which might have happened on any Alpine glacier. Both the science and the art of wintering in the Arctics, after the vessel has been housed over and banked up with snow, are now pretty well understood, and the rigors of the climate can be mitigated in many ways.

The great danger which the Nansen expedition must run, in common with all Arctic voyagers, is not so much in being ice-bound for long periods, as in being beset with pack-ice in an angry and comparatively open sea. This is in the far north what a lee-shore is to navigators further south. The provisions which Dr. Nansen is making against all anticipated contingencies, moreover, have the same element of speculation about them that his theory of Arctic currents has. "One of the greatest of a great man's qualities is success," and the event alone can determine whether Dr. Nansen possesses this quality of a great explorer.—*Leisure Hour.*

THE OPENING UP OF GREENLAND.

EIVIND ASTRUP, Lieutenant Peary's sole companion on the expedition across Greenland last year, from Inglefield Gulf on the west to Independence Bay on the east coast, and back, has just left Christiania to take part in the new expedition, under his old leader, to the same regions of that Arctic world. He takes with him sledges, ski, boots, tents, and other articles which have been manufactured in Norway for the use of the party, according to his designs and under his supervision. Lieut. Peary's expedition this year consists of ten men, and left America for Inglefield Gulf on the 20th of July. There the party will winter, and in March seven of its members will cross to Independence Bay, leaving three in charge of the home station. From Independence Bay, where a depot will be formed and left in charge of two men, whose duty it will be to hunt and accumulate stores of flesh for the dogs, Peary and one man will proceed northward, to survey and map the Greenland coast, if possible, round to the furthest point reached by Lockwood, of Greely's expedition. They will also look for the islands or land to the north which are supposed to have been sighted on one or two occasions. Should

THE OPENING UP OF GREENLAND.

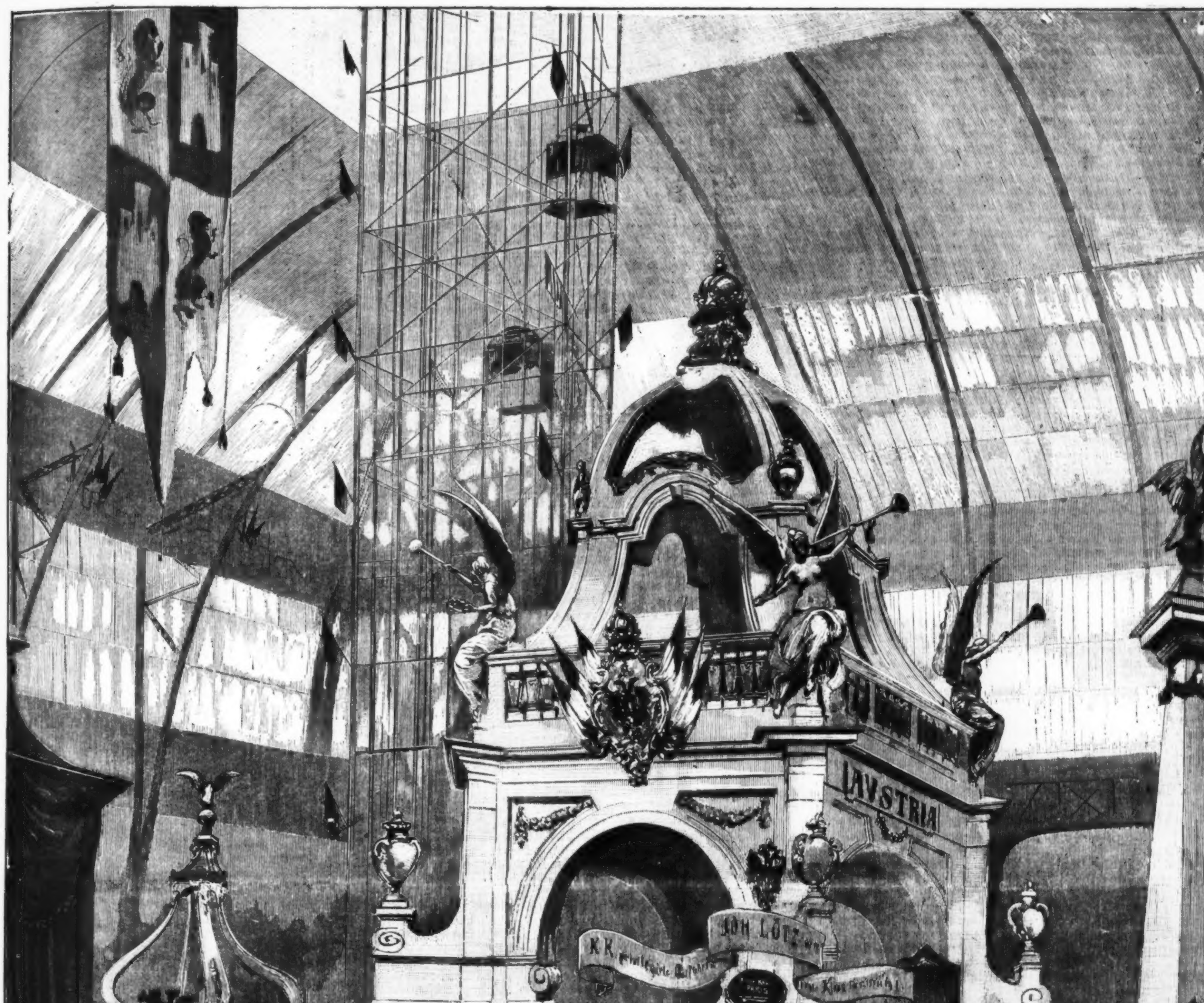
circumstances permit, Peary will endeavor to reach the Pole, but this is not the object of the expedition, neither will he risk health or life in any vain attempt to reach the culminating point of Arctic ambition. In the meantime three others will advance southward to survey and map the coast from Independence Bay to Cape Bismarck, whence they will direct their course straight across country for the headquarters at Inglefield Gulf, where Peary, after picking up the men at Independence Bay, hopes to rejoin them after accomplishing his task in the north. The expedition will winter there, and return to civilization in 1895.

During the course of the past six months Astrup has had three sledges so constructed that by means of canvas coverings they can be converted into handy little boats. He takes with him a silk tent for three men, and fourteen pairs of ash and sycamore ski of special pattern, some being over 10 feet in length, furnished with pigskin strappings, pigskin being the only material suitable for binding purposes in excessive cold. He also takes ten pairs of Scandinavian "Laupar" shoes and one pair of boots, the advantage of these being that the foot is incased in one piece of seamless leather, to which a sole can be attached if required. All these have been soled with a view to preserving them from the effects of the rough country when once the snow cap is left. The costume is of reindeer, dog, and wolf skin, of Eskimo pattern, and very roomy, as loose clothing is far warmer than tight fitting garments. Astrup has commenced Arctic research early in life, under good leadership, and possibly has a great future before him, being now but twenty-one and a half years of age. Peary's former expeditions, as well as those of Nordenskiöld and Nansen, have proved that the Greenland ice plains do not present any obstacles to progress or existence which human courage and human foresight cannot easily overcome, and the present expedition has not been founded on any rash theory, but on experience bravely gained by Peary and Astrup in the preceding year. It may, therefore, be assumed that this unpretentious little expedition will accomplish its mission successfully, to the honor of all concerned and the benefit of that scientific world which knows of no nationality.

The natives of Greenland among whom Peary and his companions will live during the next couple of years are more primitive than their countrymen in the more southern regions of the country, but have the same language and habits, similar canoes, boats, appliances, and weapons, with the exception of firearms, their substitutes being bows and arrows; while ivory is employed where the others now use iron or steel. They are not nearly so dextrous in managing the "kajaks," or canoes, as the Danish Eskimo, because, with the exception of about a couple of months each year, their chief hunting is confined to the land and the ice. They are a healthier and more vigorous race than their southern brethren, illness being apparently unknown among them.—*Daily Graphic.*

THE WORLD'S COLUMBIAN EXPOSITION—THE AUSTRIAN SECTION IN THE PALACE OF INDUSTRY.

ON the day that the Exposition opened, says the *Illustrirte Zeitung*, the Palace of Industry, the largest building that had ever been erected, was bare and incomplete. Most of the foreign sections were still nailed up, and even in the American sections there were mountains of unopened boxes and cases. Only two sections made a notable exception; the German and more particularly the Austrian exhibit which is next to it—a real oasis in this waste of cases and covers. To be sure, the Austrian exhibit does not cover as much space as that of its friendly neighbor, for strange to say, the Hungarian part of the empire is the only one of all the civilized nations of the world that is not represented at the Exposition, and many of the most important Austrian industries are surpassed by the American exhibitors in Jackson Park, to the regret of the admirer of Austrian art industry, which has a large market in America. So much more commendable is the result which the commissioners have accomplished with the limited means at hand. The artistic facade of the Austrian section with its beautiful high pavilions joins the facade of the German section worthily; it is not so monumental, not so grand, but, perhaps, more elegant. The ordinary, greater manufactures are sparingly represented, and,



THE WORLD'S COLUMBIAN EXPOSITION—THE AUSTRIAN SECTION IN THE PALACE OF INDUSTRY.

therefore, the artistic work comes more noticeably to the front. Who does not know the attractive work of the Bohemian glass factories, the beautiful work in leather, bronze, enamel, ivory and mother of pearl, in which the Austrians have long surpassed even the French, and the innumerable so-called "gallantry wares," those Austrian specialties with which they have been so successful in the market of the world? Who does not know the elegant bent wood furniture? This has conquered the continents of the world. I have found it in India and Africa as well as in the West Indies and South America; there it is the favorite furniture, and also in the western part of America its use is increasing. The Bohemian glassware also has a good market here, and generally ornaments the tables of rich Americans. Few sections of the Exposition will be visited with more pleasure by the elegant world than the Austrian section, and the numerous articles of bric-a-brac ornaments for the desk, maps, picture frames, boxes, money and cigarette cases, meerschaum wares, etc., find many purchasers. But Austria is worthily represented elsewhere in Jackson Park. In the Art Gallery the paintings of Austrian artists are much admired; in the Midway Plaisance there are Vienna cafes and bakeries, and the fine piece of Old Vienna is one of the things that is best worth seeing in Jackson Park.

The skillful hand of the artist draughtsman has indicated, with a few lines, a remarkable structure in the background of the Austrian section. The roof of the gigantic Palace of Industry forms a fine point from which to obtain a view of the Exposition grounds and of the immense city on Lake Michigan. And since elevators play so important a part in America, the good idea occurred to some enterprising person to erect an elevator in the middle of the Manufactures building, by means of which people can reach the roof, which is 262 feet high. The steel frame of the elevator is as delicate as a spider's web, and to one who sees the free car slide up and down at a mad rate of speed between the slender posts of the shaft it seems frightful. But the Americans are accustomed to such breakneck structures, and the elevator does a great business. All day long one sees many people, of course no larger than ants, walking on the dizzy height of the Palace of Industry, and when the great summer heat comes, there will be no more airy, cool place. But just the vertical journey through the immense space of the Manufactures building is interesting, for thus one has a bird's-eye view of the separate sections of the different countries, and realizes the greatness of the hall that contains them all.

Ernst. v. Hesse-Wartegg.

Drawings by C. Limmer, special artist of *Illustrirte Zeitung*.

THE COLUMBIAN EXPOSITION.

ROSES.

No other floral display of the horticultural department will be likely to awaken such interest as the roses have done. The last days of June and the first days of July have seen all the rose plantations in excellent bloom. The chief interest centers about the rose garden in the southeastern portion of the island, for not only have the displays there been good, considering the conditions, but there is something of unusual suggestiveness in a garden given over bodily to a wealth of roses. This rose garden comprises a little less than an acre of land, in rectangular shape and surrounded by a chain fence. It is laid out in the geometric fashion and comprises forty beds, four of which are filled with clematis.

In design this garden reminds one of a gigantic hot-air register. It is a matter of doubt whether this is the best form in which the rose garden could have been cast. From an artistic point of view, some freer and more natural arrangement of groups or clumps upon the sward would probably have been better; but it must be considered that the plants were received so irregularly that little definite planning for effects could have been confidently made, and the plants are also so small that they would have given little character to any bold system of grouping.

In considering the ornamental plantations, one must remember that the soil is but a shallow covering of black earth, and that it is loose and droughty; and in the rose garden there is no soil which is adapted to roses. The gardeners also complain that the intense suns of the American climate burn out the more delicate roses as soon as they open. Yet, despite all this, the intelligent visitor must concede that the rose garden is a success. A low trellis bounds the garden just inside the fence, and most of its length is covered with the wonderfully profuse bloom of the rose Pride of Washington, furnished by the Dingee & Conard Co. A small portion of the trellis was planted to Baltimore Belle, but this has failed to make any show. Each of the interior beds contains but a single exhibit, although an exhibitor may have several beds. Many of the beds are without labels, either of the exhibit or of individual plants, and much of the value of the displays is thereby lost. It is, furthermore, impossible to find official records of some of the exhibits. The following inventory of the exhibitors and the numbers of varieties now living in the rose garden, together with date of setting, has been obtained with great care, and it is the most complete record yet published:

1892. E. Asmus, West Hoboken, New Jersey, 2 varieties, hybrids.
1892. Robert Craig, Philadelphia, 2 varieties.
1893. Alexander Dickson & Sons, Newtownards, Ireland, 20 varieties.
1893. Alexander Dickson & Sons, Newtownards, Ireland, 3 varieties.
1892. California exhibitors, 35 varieties, hybrids.
1893. California exhibitors, 24 varieties, hybrids.
1893. California exhibitors, 67 varieties, teas.
—— Dingee & Conard Co., West Grove, Pennsylvania, 3 varieties.
1892. Boskoop Nursery Association, 144 varieties, hybrids. A few of these have died.
1892. M. Jeurgisson, Boskoop, Holland, 60 varieties.
1893. E. G. Hill & Co., Richmond, Indiana, 20 varieties, teas and polyanthas.
1892. Nanz & Neuner, Louisville, Kentucky, 15 varieties, hybrids.
1893. Nanz & Neuner, Louisville, Kentucky, 17 varieties, teas.
1893. John N. May, New Jersey, 4 varieties, teas.
1892. Ohio exhibitors, 10 varieties.
1893. Pitcher & Manda, New Jersey, 30 varieties, hybrids.
1893. E. Seyderhelm, Buda-Pesth, Austria, about 200 varieties, standards.
1892. J. C. Vaughan, Chicago, 1 variety.
1893. German exhibitors, about 500 varieties, hybrids, teas and standards.

Aside from these, there are on the island about sixty varieties of standards from W. Van Kleeff & Sons, Boskoop, Holland; a large lot of standards from the German department (included in the above estimate of 500 varieties); a lot of Marshall P. Wilder, very fine, from Ellwanger & Barry, and an attractive little bed of Dawson and Rosa Wichuriana by W. C. Strong, of Massachusetts. The latter are not yet in flower.

About the Woman's building, among the French plants, are collections of roses: 1. By L. Paillet, Vallee de Chatenay, near Paris, about 100 varieties, all standards. 2. By G. Boucher, Paris, about 200 varieties of standards and many low plants. 3. By Levavaseur & Son, Ussy, France, of Rosa rugosa. There is also a collection of imported standards shown in the New York exhibit in the rear of the Horticultural building by Gabriel Marc & Co., Woodside, Long Island. Finally, about the California State building, there are several tree roses, six to eight feet high and in full bloom, which attract considerable attention.

In all this abundance of roses it is impossible to single out any one exhibit as better than all others. Yet, so far as novelty and striking merit of varieties are concerned, the exhibit of Dickson & Sons, Ireland, probably excels. This firm originates varieties, and it needs no introduction to American rosarians. Among the striking roses in this exhibit are Mrs. John Laing (of which the head gardener is very proud), Margaret Dickson, Earl of Dufferin, Madame Plantier, Jeannie Dickson, Marchioness of Dufferin, Blanche Moreau, and Celine, the last two being moss roses.

The German exhibit is the largest. It is made up of about ten different lots, from as many German growers. The entire German horticultural interests are in the hands of Ludwig Schiller, who considers the following varieties to be among the best of those under his charge: Of standards, Marie Baumann, Victor Verdier, Lady Mary Fitzwilliam, Fisher Holmes, Sappho, Alfred Colombe, Baroness Rothschild; of low hybrid roses, Merveille de Lyon, Pride of Waltham, Captain Christy, General Jacqueminot, Jean Liabaud, Anna Alexieff, Anne de Diesbach, Auguste Neumann, Baroness Rothschild, Etienne Levet, La France, Mrs. John Laing, Souvenir de Paul Neyron; of teas, Mlle. Franzisca Kruger, Madame Honore Defresne, Reine Nathalie de Serbie, Sunset, Marie Guillot, Grace Darling, Souvenir de Victor Hugo, Perle des Jardins, Viscountess Folkestone, Gloire de Dijon, and Kaiserin Augusta Victoria, the new white tea.

The California roses are very strong and free blooming, and have been among the best show plants in the garden. American Beauty and Mignonette have been particularly good in this collection. Other prominent varieties are Clothilde Soupert, shown by Vaughan, and Ulrich Brunner, shown by Craig. The latter is only semi-double, and the bud is very attractive.

With the exception of the plants of Nanz & Neuner and the Clothilde Soupert, by Vaughan, all the hardy roses are budded. This fact proves that nearly all dealers prefer such stock for strong growth and quick results; and if the plants are set deep enough, so that the bud is three inches below the surface, it is commonly agreed that budded plants are superior to others for outdoor planting. The standard roses are a surprise to many Americans. The rose is budded four or five feet high upon a straight slender stock, which is stripped entirely of its leaves after the bud begins to grow. In the specimens on exhibition the bud is two seasons old, forming a compact little bush or bunch on the apparently dry cane. These plants are set in rows or other formal fashion, and most of them are tied to strong green stakes. These tree or standard roses are much used in Europe for planting in the centers of foliage or bulb beds, or for use as supports to ipomœas or other climbing plants. Any variety of rose may be worked or budded in this manner. In France and Germany, yearling standard buds sell for twenty-five to fifty cents apiece. Because of the difficulty of protecting them in winter they have never become popular in this country; and it should also be said that the American taste tends toward more naturalistic methods of treatment. Mannetti stocks are sometimes used for these standards, but seedlings of the Rosa canina are oftenest employed, both in Germany and France.—*L. H. Bailey, in Garden and Forest.*

INTERESTING FACTS CONCERNING WOODS.

At the recent World's Fair International Forestry Congress, Chicago, the following paper by Mr. Saley, editor of the *Northwestern Lumberman*, was read:

I was asked that my subject be the manufacture of lumber in the United States, but chose another. The public should hold rather firmly to the opinion that unless a man can say something new, or at least something that will set his readers or listeners thinking, he squanders more time than his own. I could give you statistics by the wholesale pertaining to manufacture, but these statistics have in large part appeared in lumber journals, and consequently are history. Therefore, what I might have to say on the subject would be largely what has been said before.

It might also astonish many people to learn how incomplete the data concerning manufacturing are. It would be easy to follow the evolution of the sawmill; it would be easy enough to tell you approximately how many mills there are, how many miles of logging road, how many men are engaged at the mills and in the woods, but when it comes to the more vital questions, namely, the amount of this, that and the other kinds of lumber cut, or the grand total of lumber produced in the United States, no man can answer them. It is known how much white pine is cut yearly, about how much redwood and Oregon fir, but nobody is so wise as to inform you how much hardwood or yellow pine comes from the saws. The basis on which at any time I make an estimate of the total production is that the consumption of lumber in the United States is 500 ft. per capita. We have in round numbers 65,000,000 inhabitants, and this number multiplied by 500 gives 32,500,000,000, the number of feet. This I believe to be approximately correct.

I trust that our foreign friends may not marvel at this confessed ignorance regarding our lumber output. Other manufacturing lines, like iron and cotton, are carried on at centers, or in districts. Not so with lumber. In every one of our States and Territories there are sawmills, and they are located in the back woods, at railway crossings, and up streams. In many instances sawmills and post offices are not neighbors. There is no congestion in the manufacture of lumber. It is produced literally everywhere. To cover the lumber district, which means the area of the United States, is a task which no publisher has attempted or probably ever will attempt. For many years the paper that I edit has collected the figures pertaining to the cut of white pine—that wood furnishing about a quarter of the total output—a task that of itself requires an outlay of quite enough time and money. If any listener should still think that the figures covering the entire country might in the natural course of human enterprise be collected, let him confer with our government officials who have charge of the present, or eleventh, census, and he will disabuse his mind of the idea, as government thus far, with its army of enumerators, has failed to accomplish its desire in that direction. Statistics for the census pertaining to the lumber output are still incomplete, and I predict that they will remain so.

This ignorance concerning the output of lumber in the United States drops naturally in as a phase of my subject.

In the shoe and leather building on these grounds, the booth of the Pfister & Vogel Leather Company is of surpassing beauty. The other day a Boston lumberman who has handled boards for a quarter of a century said to me he thought the wood was white mahogany. The booth of the National Linseed Oil Company in the agricultural building is constructed of the same kind of lumber. The banquet hall in the Auditorium hotel is finished in this lumber, and let me say that of all the people, lumbermen as well as others, whom I have run up against the finish in that hall, not one of them has correctly named the wood. One man said that the trim excelled in beauty the onyx which is so profusely used in the office of the hotel. Yet the wood is plebeian birch. This banquet hall, which ranks as the finest in the United States, is finished in a wood which a few years ago was considered of no importance; a wood so beautiful as to throw even lumbermen off their guard, in an attempt to name it, and which sells to consumers in the Chicago market at from $40 to $45 a thousand.

Redwood comes in for its share of non-appreciation, owing to the fact that its qualities are not known. Effort has been made to introduce it into Eastern and into what we know as Western markets, but a Californian will tell you with unsatisfactory results. It is a beautiful lumber, wide and clear. It has a quality as distinct as the territory in which it grows. While not a veritable salamander, it is closely related to the salamander tribe. The district bounded by the fire limits of San Francisco is smaller than that of any other city of its size in the country, one reason being that the buildings are constructed largely of redwood, and will not easily burn. If I may judge, this is a rare quality in any building wood, especially for residence purposes. Yet so little is said about it that this information will undoubtedly be news to many. Redwood shingles are sold to a considerable extent east of California, but I have never heard of a lumber merchant using the argument when trying to make a sale that the shingles will not readily burn. He says the redwood is a well made, clear, durable shingle, and of a pretty color. Ten to one, if you are in a gambling mood, he knows of no other taking adjective to apply to it. The shingle is all that, and more. Why does not the dealer, say, "I want to sell you this shingle, for I believe you are a man of too much sense to desire that you or your family be incinerated. Cover your house with this material, and when the dwellings and barns of your neighbors burn, the sparks will not set on fire your roof." That certainly would be a convincing argument, but it is not made use of.

Touching on the shingle question, there are builders who really believe that the old-fashioned white pine shingle is out of the race. Cypress, red cedar and redwood are in fact supplanting it, but not for the reason that they are driving from the markets a poor roofing material. This shingle controversy is really amusing. Manufacturers tear from old roofs the kinds of shingles in which they are interested and hold them up to illustrate how durable they are. The fact is that a shingle of any of the woods named, or even of a meaner wood, would keep our heads dry as long as it will be necessary to protect them from dampness. To make shingles last still longer, lower, as some would say, the grade of them. That may sound paradoxical, and I am not aware that the theory holds in any other line. "A good thick shingle" is a term often heard. My preference would be to cover a building with a good thin shingle. A shingle, as a rule, wears out instead of rotting out, and the thinner the butt over which the water runs and drops on the shingle below, the longer the shingle underneath will last. A steady dropping, it is said, will wear away a stone, and the shorter the distance the water falls, the longer the stone will last. This philosophy applies with great exactness to the durability of shingles.

Going back to redwood, it is not generally known that outside of burls the choicest part of the wood for ornamentation is in the stump. There is money in these stumps, and by and by they will be made to yield it up. There is one consolation in this prospective industry—the stumps will wait for us, for as men count time they never decay.

Within three weeks a Tennessee mill man sent me a sample of as fine red oak as I had ever seen, and asked if such oak is salable. The Tennesseean is not alone; people generally are ignorant of the value of red oak. Neither is he far behind a multitude who live nearer market centers than he. Only a few years ago red oak was not considered worth the space the tree occupied in worthless land. Its cheapness, its plentifulness, its beauty went for naught. Buyers and builders, with teeth set, had their faces turned toward white oak. They appeared to think that white oak was su-

preme, just as some dealers to-day think that white ash is, and buy other varieties only when unbeknown to them they are mixed with white, and they pay white ash prices for the whole lot. Wherever red oak has become known it has gone to the front. For house finish it has a warmth of color that white oak does not possess, and in certain sections of the country there is hardly a fine residence built in which this cheap wood does not enter. In some of the larger markets red oak for inside finish has the call, and for this use its value will in due time be recognized everywhere, I believe.

That rats will not gnaw hemlock is about the only good word said of that wood by many. The statement, however, is fiction. It may create confidence on the part of the men who build cribs and bins of hemlock, but it never discourages the rats. To be sure, a rat would rather gnaw some softer thing, less slivery thing—cheese, say; but given a hungry rat, something to eat if he can only get at it, and a hemlock board between them, and he will get at it. It is not necessary to bolster up hemlock with this rat story. It can of itself stand alone if given a chance to do so. In the great West it is working hard to earn some kind of a decent rating among other woods. In lower Michigan there are billions of feet of good hemlock, and in northern Michigan, in Wisconsin and in Minnesota it stands in large quantities. Even now I believe it is sometimes made to masquerade in the Chicago market under assumed names. One concern was enterprising and sensible enough to put in a yard stocked exclusively with hemlock, and honest enough to call the wood by its real name. The enterprise, I am glad to say, is a success. All over the prairie States, where if anywhere builders stand in need of good and cheap lumber, hemlock is held in disrepute simply because its nature is not understood. You who have lived in the East know more about hemlock than do they who in the West reject it. In the Eastern States it is used for dimension, barn boards, fencing, and answers for such purposes admirably. For dimension there is nothing better. It dries out light, is strong and elastic. White pine will be practically gone by and by, and hemlock to a certain extent will take its place. It is manufactured into lumber in increased quantity every year. Six years ago hemlock lands in Michigan were not considered of sufficient value to warrant the paying of the taxes; for years ago stumpage had reached a value of 50 cents a thousand, and at present it is worth three times that amount. Western builders will have to come to it, and they will consider it no hardship once they make its aquaintance. It is not to be wondered at that the lumbermen of the Puget Sound district recently proclaimed that they would have no hemlock in theirs, that their hemlock should hereafter be known as Alaska pine. Having witnessed the reluctancy with which hemlock was adopted as a building timber to the east of them, they thought that to change the name of the wood might disarm criticism to some extent. We trust it may. The senseless tirade against hemlock should have had its day long ago, and any little scheme to check it may be forgiven.

It is a little late in the day to say much about cherry. I may briefly add that when there was in market as much cherry lumber as consumers wanted, people were ignorant of its nature, and continue to remain ignorant of it now that it has become scarce. People asked for cherry without gum spots, the very peculiarity of the wood that brands it as genuine. Art can produce so-called cherry made from other wood that will deceive any but an expert, and users by a large majority have been better satisfied with this bogus cherry because it did not have the peculiar little marks—defects they called them—which nature gives to the genuine. There are carloads of furniture in every town of considerable size made of inferior, stained wood and sold for cherry. This would not have been had the significance of the little gum spots been understood. Not everybody may find it in his mind, however, to seriously blame the furniture men for the deception, for had they offered the genuine the housewife would not have had it.

Another wood that is not understood is red gum. Its beauty makes friends at first sight. The delicate shading and interlacing of grain make it a distinctive wood. It finishes easily, the tool leaving a surface that requires but little, if any, filling. It is a comparatively new wood in Eastern and Northern markets, and its standing illustrates how difficult it is for a wood, as well as for an individual, to shake a bad reputation. Gum, owing to the ignorance of the nature of the wood by those who handle it, made a poor start. Its beauty was recognized and extolled, but its warping quality was as a millstone around its neck. I once offered a prize for a piece of gum that would not warp. The Rev. Mr. Abbey, of Yazoo City, Miss., a gentleman who had a fervid love for trees, and who saw in gum the future that he believed and which I believe it is destined to have, wrote columns in favor of the wood and said that most certainly in my estimation of it I labored under a mistake; that the gum of the Mississippi delta was not of the warping kind. He was asked to express a piece to Chicago, which he did, and having passed through the cabinet maker's hands it was laid away. Did it warp? It assumed the shape of a section of a big eaves trough, and that knowledge must have wounded the soul of the dear old man, for I never heard from him again.

Amusing stories have been told of the warping propensity of gum. One man said he built a hen coop of it, and by noon it had turned inside out and released his chickens. Another said that he made a cradle of it, and while his wife was getting dinner the cradle warped the baby onto the floor. Of course an Ananias flavor surrounds these tales. Gum, notwithstanding it was bad enough, was not as bad as all that. But we came to understand it. It can be so treated that for finish it will stay in place as well as any other wood. One method is to deaden the tree and give the wood time to season before sawing it into lumber. Another is to saw the log into cants and after the cants are dry resaw them. Many insist that if placed on sticks with care, and so remain until thoroughly seasoned, its conduct is thereafter perfectly proper. The result of the study of gum unfortunately, however, does not overtake in the public mind the unfavorable results which followed its use before its characteristics were understood. It cannot be too generally known that the wood has been shorn of its intractability. For the sake of variety it deserves to be more used. In many a fine residence the most beautiful room of all is the one finished in gum. No wood is more pleasing to the eye. As material for a floor that will wear smooth and stand a great deal of wear, gum is overlooked.

The way that lumber is sawed has much to do with its conduct and beauty, and in touching on this phase of my subject, justice would not be done were I to leave unmentioned the name of I. L. Quimby, whose home was in Grand Rapids, Mich. Years ago when he visited Chicago he would sit by my desk for hours dwelling on the merits of quarter-sawed lumber. On one occasion he said, "I want to impress this matter on your mind so that quarter-sawing will have an advocate after I am gone." That was before quarter sawing had figured in a commercial way in the lumber industry and was little known except in the manufacture of musical instruments. The old gentleman is gone. He was a kindly, odd man, and knew more about the characteristics of wood than any other man with whom I have ever come in contact. In a practical business extending through many years he carried the habits of the student. To him, in my opinion, the wood ushers of America are indebted more than to any other man. He taught how to secure the minimum of shrinkage and warp, how to bring out a beauty of grain foreign to lumber bastard sawed, and how to secure greater durability when lumber is subjected to hard wear. The finest furniture is now made of quarter-sawed lumber, the finest finishing is quarter-sawed, as is also the best clapboarding and the best flooring. The common users of lumber, both for furniture and finishing, need, however, to know more about the merits of quarter-sawed stuff. Such a knowledge acted upon would be money in their pockets, and a pleasure to the eye.

If I were to arraign more severely one class of men than another for their ignorance concerning woods, it would be our architects, for the reason that it is their business to know. They can tell us about the wearing quality of different stones, the crushing strength of this material and that, but when it comes to any specific knowledge of the lumber used inside of our houses for doors, casings, floors, mop boards and possibly ceilings—objects which are constantly before our eyes—they are wofully ignorant. When furnishing a fine house you select for one room furniture, carpets and draperies of colors to blend, and for adjoining rooms other shades to carry out a general idea of harmony. If the upholstering of the furniture, the carpets, or the portieres were to turn another color, the harmony would be destroyed. So it may be destroyed through the lack of knowledge on part of the architect. Were you to ask the question, "I desire to finish my front parlor in one kind of wood, my back parlor in another, the reception hall in another, my library in another; now as these rooms are practically one, what woods shall I use in order that the harmony may be preserved after the house shall have been in use for years?" I am fearful you would fail to find an architect who could answer it. Architects pay little attention to these vital points, which are really most intimately connected with their business—in fact, are and should be regarded as a part of their business. I am not aware that an architectural journal has given a line to this subject, and the furniture papers are equally dumb.

Exposure has much to do in changing the color of wood. There is a piece of wood on my desk of a rich, dark brown color, and no man into whose hands it has been placed has rightly named the kind. The color which age has given to it misleads as to its identity. A shaving taken from it with a knife reveals a bright saffron color, for it is nothing but osage orange. It has been remarked that yellow pine as finish is too glaring; for no great length of time will it offend the supersensitive eye in this respect, however. It becomes darker and darker until it acquires the shade of old mahogany.

The grainers' occupation is gone. No man can now earn a living by counterfeiting woods. People have learned in this line that nature surpasses art. Even in many of the cheaper dwellings now erected the finish is in natural wood. Considering the fact that wood in its natural state is used so extensively, it seems to me that architects and builders should make a study of it. A purveyor of cypress who recently canvassed New York told me that he talked with architects who did not know what cypress was. A wood that for doors and trim is excellent, that for purposes where it comes in contact with dampness has not in a domestic wood an equal, that is rapidly gaining headway in many markets, yet architects do not know what it is! Let us hope that when the custom of natural finish shall have acquired greater age, the men who prescribe woods will be able to inform their customers more about their wearing qualities, and more about the extent to which they will shrink and warp.

A proper extension of the subject that I have chosen would fill a volume. I have briefly referred to a few of our commercial woods which are so low in price as to be within the reach of the man who builds a modest home. A knowledge of these woods carried into practice would add to the value of the buildings erected. There is no reason why the moderate priced cottage should not present a beautiful wood effect, and there are good reasons why better effects than are often observed should be produced in high grade residences.

Naturally in the evolution of things people will become better posted in wood. From the lumber journals they will learn much. I am sorry to say there is not much collected literature on the subject. Prof. Sargent has given to us his book on the "Forest Trees of North America," which, barring the estimates of standing timber, is an admirable work. That great university the Forestry building of the Exposition will teach the people much. No such exhibition of wood was ever before seen. For the next exposition of this kind I want to suggest that some man immediately make a collection of our furniture and finishing woods in the shape of boards, plane them smoothly, and hang them on the wall. At the exposition which will be held in Paris in 1900, hang these boards alongside of others of the same varieties freshly finished. In this way the effect of age on the different kinds of wood could be studied.

I wish it were not useless for me to criticise the altogether too conservative policy of government regarding its appropriations for the forestry division of the United States department of agriculture. This division is promulgating information that will assist the people in arriving at an understanding of the merits and demerits of wood. I will cite one instance. Pine in the Southern States which would produce billions of feet of lumber has been tapped for turpentine. From the beginning of the turpentine industry there has been an idea, a notion, a whim that lumber and timber cut from these tapped trees were of less value by far than if cut from trees which had not been tapped. This idea worked injustice and financial injury to the owners of tapped timber. They were at great disadvantage in any attempt to market their product; if it came from a turpentine orchard, it was branded as next to worthless. The paper with which I am connected controverted the opinion so generally held that timber which had been tapped deteriorated in quality, claiming that so long as no man could tell the difference between lumber or timber cut from tapped and untapped pine when laid side by side, there could be no material difference. The paper, however, did not argue from a scientific standpoint, but purely from what it would call a standpoint of common sense. It remained for Mr. Fernow, chief of the forestry division, to handle the matter scientifically, and only a few months ago he announced that thorough experiment had proved that in no wise are the chemical or mechanical properties of yellow pine affected by the tapping of the tree for turpentine. Neither you nor I can estimate the value of this discovery. This exploding of the old erroneous theory—exploding it scientifically and in a way that it will stay exploded—will enhance the value of timber in the turpentine regions millions of dollars, and practically enlarge our available timber area. This is what the forestry division is doing—spreading knowledge concerning woods. The opinion seems to be held by many that the division has to do with technical forestry only. That is an error. Its experiments and investigations are of a direct moneyed interest to lumbermen and builders everywhere. It diffuses information that will assist them in a better understanding of the material that they handle. Secretary Morton, knowing the needs and value of that division of his department, will, we trust, so far as his influence can go, see that it be hampered as little as possible for lack of funds.

JUTE.

JUTE is largely cultivated in the northern and eastern districts of Bengal, and, to a smaller extent, in the central districts of the province. It is grown also, although not extensively, in Assam. The United States consul general at Calcutta says that jute seems to be capable of cultivation on almost any kind of soil. It is least successful, however, upon laterite and gravelly soils, and most productive upon a loamy soil or rich clay and sand. The finest qualities are grown upon the higher lands, upon which rice, pulse, and tobacco form the rotation. The coarser and larger qualities are grown chiefly upon mud banks and islands formed by the rivers. When the crop is to be raised on low lands, where there is danger of early flooding, plowing begins earlier than upon the higher lands. The preparation commences in November or December in the low lands, and elsewhere in February or March; the soil is plowed from four to six times, the clods pulverized, and, at the final plowing, the weeds are collected, dried, and burned. No special attention is paid to good seeds, nor do cultivators buy or sell their seeds. In the corner of the field a few plants are left to ripen and produce the seed that is sown broadcast the following year. The sowings, according to the position and nature of the soil, begin about the middle of March and extend to the end of June. The time for reaping the crop depends entirely on the date of sowing, the season commencing with the earliest crop about the end of June and lasting until October. The crop is considered to be a season whenever the flowers bloom, and to be past the season whenever the fruits appear. The fiber from plants that have not flowered is weaker than from those in fruit; the latter, though stronger, is coarser and wanting in gloss. The average crop of fiber per acre is over 1,200 lb., but the yield varies considerably, being as high as 4,000 lb. in some districts and as low as 250 lb. in others. At present, as practiced by the natives, the fiber is separated from the stems by a process of retting in pools of stagnant water. In some districts, the crop is stacked in bundles for two or three days to give time for the decay of the leaves, which are said to discolor the fiber in the retting process; in others the bundles are carried off and at once thrown into the water. In some districts the bundles of jute stems are submerged in rivers, but the common practice seems to be in favor of tanks or roadside stagnant pools. The period of retting depends upon the nature of the water, the description of fiber, and the condition of the atmosphere, and it varies from two to twenty-five days. The operator has, therefore, to visit the tank daily to ascertain if the fiber has begun to separate from the stem. This period must not be exceeded, otherwise the fiber becomes rotten, and almost useless for commercial purposes. The bundles are made to sink in the water by placing on them sods and mud. When the proper stage has been reached, the retting is rapidly completed. The laborer, standing up to his waist in the water, proceeds to remove small portions of the bark from the ends next the roots, and grasping them together, strips off the whole from end to end without breaking either stem or fiber. Having brought a certain quantity into this half prepared state, he next proceeds to wash off, which is done by taking a large handful, swinging it round his head, dashing it repeatedly against the surface of the water, and drawing it through the water toward him so as to wash off the impurities; then with a dextrous throw he spreads it out on the surface of the water, and concludes by carefully picking off all remaining black spots. He then wrings it out so as to remove as much water as possible and hangs it up on lines prepared on the spot to dry in the sun. There are in India 26 jute factories, 8,101 looms, and 161,845 spindles, which give employment to 61,915 persons, and consume 2,860,088 cwts. of jute. They are almost exclusively employed in the gunny bag or cloth trade, a few only doing business in cordage, floor cloth, or other manufactures. San or sunn is grown by itself, or at times is raised in strips on the margins of fields, and is never cultivated as a

mixed crop. It is usually sown in June or at the beginning of the rains, and cut at the close of the rainy season—about the 1st of October. It requires a light but not necessarily rich soil, though it cannot be grown on clay. It is believed by cultivators to improve the soil; and as it is supposed to refresh exhausted land, it is considered a good preparatory crop, and is grown as such, every second or third year, in fields required for sugar cane and tobacco. The ground is roughly plowed twice and the seed sown broadcast, and as it germinates immediately, appearing above ground within 24 hours, no weeding is required. From 12 to 80 lb. of seed are used to the acre, the opinion prevailing, however, that thick sowing is more desirable. Ordinarily the crop is harvested after the flowers have appeared, but the plants are frequently left on the field until the fruits have begun to form, and sometimes until they are ripe. There is a great difference of opinion as to whether the crop should be dried before being steeped or carried at once to the retting tanks. When stripped of the leaves, which are highly esteemed as manure, the stalks are made up into bundles and placed upright for a day or two in water a couple of feet deep, since the bark on the butts is thicker and more tenacious than that on the upper portion, and, therefore, requires longer exposure to fermentation. The bundles are then laid down lengthways in the water, and kept submerged by being weighted with earth. It can generally be ascertained when the retting is complete by the bark of the lower ends of the stems separating easily; but too long fermentation, while it whitens, injures its strength. Having discovered that the necessary degree of retting has been attained, the cultivator, standing in the water up to his knees, takes a bundle of the stems in his hand and thrashes the water with them until the tissues give way and the long clean fibers separate from the central canes. When the fiber has been separated and thoroughly washed, it is the usual custom to hang it over bamboos to be dried and bleached in the sun. When dry it is combed, if required for textile purposes or for nets and lines; but if for ordinary use for ropes and twines, it is merely separated and cleaned by the fingers, while hanging over the bamboo. The output per acre of san fiber ranges from 150 to 1,200 lb., but the estimated average is 640 lb. to the acre. The chief purpose for which san is utilized at the present day is the manufacture of a coarse cloth or canvas, used principally for sacking. A large amount of the fiber is used in the native cordage trade, for which it is stated to be well adapted, and considerable quantities of the fiber are also consumed by the European rope makers in India. The waste tow and old materials are made into paper. In many districts paper is regularly manufactured of this material, and large quantities are used by the Indian paper mills. In some parts of India the seeds of the san are collected and given to cattle. The plant itself is found to be very nourishing, causing cows to give a larger supply of milk.

UNITED STATES PITCH-PINE INDUSTRY.

THE British vice-consul at Pensacola says that the immense quantities of pitch-pine wood, hewn, sawn and manufactured, which have been shipped from the United States—notably to the United Kingdom—for so many years past, and which are still being shipped without any diminution, leave it apparent that information on this subject, generally, and particularly on the probable length of time that these pitch-pine forests will hold out, will be of value and interest to the principal dealers in this great article of trade. The pitch-pine trees of the Southern States are of spontaneous growth, and especially indigenous to those sandy soils near to the water of the Gulf and Atlantic coasts, and therefore hardly any attention is given to the culture of these trees. It is believed that the pine-wood of the Southern States is coming more and more to the front, and that it is the most valuable wood of the country for mercantile purposes, and that, as the white wood of the Western and Eastern States becomes exhausted, the Southern States will be more relied upon. It is stated by the Forestry Bureau of the Department of Agriculture in the United States that there are about ten species of merchantable pine in the Southern States: the white pine and pitch-pine, the scrub or spruce-pine, the sand-pine, the pond-pine, the cedar-pine and the long-leaf, short-leaf, loblolly and Cuban pines, which are the principal varieties in general use. There is a great deal of confusion arising from the indiscriminate use of local names for these timbers. Thus the long-leaf pine is called yellow-pine, hard-pine, pitch-pine and various other names, but the settled name of this species of wood for commercial purposes at Pensacola is pitch-pine, and this quality of wood forms the largest if not the entire bulk of the shipments of pine-wood from Pensacola. The short-leaf is called the old-field and spruce-pine, the loblolly fuel-swamp, sap-pine and Virginia pine. The most important of these woods—the long-leaf pine—grows in the Atlantic and Gulf States, at some distance from the coast, covering a belt of about 125 miles in width. Next in importance to the long-leaf pine—pitch-pine—is the short-leaf pine, and this is more widely distributed than any of the other growths of pine. It is the predominating growth in some of the Southern States, and it covers immense areas to the exclusion of almost every other tree. In Florida the short-leaf pine is found along the northern border of the State. In Western Florida, nearer to Pensacola, it approaches the Gulf within 25 miles. It is said that the short-leaf pine gives from 3,500 feet to 4,000 feet, board measure, per acre. A rough estimate places the possible standing timber of this species, distributed throughout the Southern States, at about 160,000,000,000 feet, board measure. The loblolly pine is found only in the northern part of Florida, and the Cuban pine is found principally in Florida and along the Gulf coast. It grows mainly on the so-called pine flats or pine meadows. About 12 years ago the official estimates of the merchantable pine timber standing in the Southern States gave a probable quantity of 235,000,000,000 feet. Since that time there has been an enormous quantity of timber cut, but the amount standing now is estimated as follows: Long-leaf and Cuban pine, 232,000,000,000 feet; short-leaf pine, 160,000,000,000; and loblolly pine, 102,000,000,000 feet, making a total of 494,000,000,000 feet, board measure. The long-leaf pine is known to be superior to all the other species in strength and durability. In tensile strength it is said to approach, and perhaps surpass, cast iron. In cross-breaking strength it rivals the oak, requiring, it is stated, 10,000 lb. pressure per square inch to break it. In stiffness, it is superior to oak, by from 50 to 100 per cent. It is best adapted, and much used, for the construction of heavy work in shipbuilding; the inside and outside planking of vessels taking the deals and planks of the best quality. For house-building it is used almost entirely in the district of Pensacola, and in buildings for railroads, railroad cross-ties, viaducts and trestles, this wood is foremost. The finer grades and the "curly" woods are very much used for the timber work in the best dwellings. The hardness of this wood especially fits it for planks and flooring. The finer grades of curly-pine are used for the manufacture of furniture, and it is said that for bedsteads it is admirably adapted, as the resinous wood prevents the inroads of insects and similar pests. The resinous products of pine-wood supply many parts of the world with pitch, resin and turpentine. And, contrary to opinion formerly held in this respect, it is said that the tapping of the pine tree for turpentine strengthens, instead of weakens, the wood. The Cuban pine is like the long-leaf pine, and is used in trade to a large extent. The short-leaf pine is a softer wood, and is more easily worked. This wood is admirable for house work, and is largely used by builders and cabinet-makers, and for other purposes. The loblolly pine is suited for rougher work than the other two species, but it is not so strong, and it will not last so long as the others. It is stated, in a recent report of the United States Department of Agriculture, that in respect of the pine forests of the Southern States, the supply is good for fifty years to come.

A CURIOUS TREE GROWTH.

To the Editor of the Scientific American:

Having been much interested in your illustrations of curious tree growths, I send you a print from a negative taken in Key West, Fla., by Mr. Edward H. Crain, of the Albany Camera Club. The date palm is growing from the hollow of an Indian fig, or banyan tree (*Ficus Indica*), and is apparently supported by the rootlets of the fig tree, which clasp the date for some distance.

The banyan is a small one, having only three trunks. There is a very large one on the island, which has thirty or forty trunks of all sizes.

The view is in what is called "Maloney's Garden," in which there are numbers of dates in full bearing.

Albany, Ga. CHAS. W. TIFT.

A CURIOUS TREE GROWTH.

THE BAMBOO.

THE light bamboo curtain is giving the same privacy to suburban New Yorkers this year that the Venetian blind has long given to West Indians and other dwellers in warm climates. Several years ago these rolling curtains of split bamboo made their appearance in this city under the name of Sidarris, and they were found so useful that they soon became popular favorites, particularly in the suburban towns. The suburban New Yorker had fallen into the habit of living much in public when outside the walls of his house. Fashion decreed long ago that the front fence must come down, and the piazza, usually not far from the street, was so exposed that it was useless for comfortable lounging, and demanded the same dress that must be worn for walking or calling. The bamboo curtain came to remedy this evil, and to give to the American piazza greater privacy and comfort. It is cheap enough for the smallest cottage, pretty enough for the most expensive, and useful for everybody who has a piazza. Like most things that are cheap, pretty and useful, it has made a place for itself.

Possibly there may be some remote hamlet in the United States where the bamboo curtain has not yet appeared, and for the benefit of that hamlet it may be necessary to describe it. It is simply a rolling shade made of thin strips of split bamboo, with a round bamboo rod at top and bottom to give it strength and ropes running through two small pulleys to raise it or let it down. It is so loosely made that the wind whistles through it readily, yet it has enough solidity to make a shield from the sun. It may be run up or down as easily as any shade, and it is not only a protection against the sun, but a valuable screen to shield the summer lounger from the gaze of every passer-by. It is used only upon the piazza.

The bamboo curtain is too familiar hereabout to need any description for the New Yorker, urban or suburban; but there are some curious things about it that must attract the idle notice of the summer lounger. It has a foreign look throughout, and seems to bear the delicate odors of lacquer and fine cabinet work that we associate with Japan. The slats are tiny things, perhaps a quarter of an inch wide and a sixteenth of an inch thick. Wherever the marks of a joint appear, they are not in one slat or two, but in enough of the slats to cover a foot or more in height, and each one exactly over the one below it, showing that all those slats have been deftly cut from one stalk of bamboo. So neatly and evenly is this cutting done that the summer lounger is likely to wonder at the patience and dexterity of the Japanese workmen who make these things.

But the patient Japanese workmen who make these screens are usually good American citizens, and all the foreign look is manufactured to order, and by machinery. It is not in Tokio or Yokohama that the bamboo curtains are made, but in New York or Brooklyn. Sidarras is a good name for them, because it has a far-away sound, and few people know what it means. The bamboo is a genuine product of the tropics, but the manufacturing is all done on one side or other of the East River; largely in Brooklyn, and not far from the Navy Yard. This applies, however, only to the bamboo shades and other bamboo work used in and about this city. Nearly every large city in the country has at least one factory where bamboo goods are made. Some of the largest of these factories, after those of New York and Brooklyn, are in Philadelphia, St. Louis and San Francisco. In all of these factories, although the price of labor is twenty times higher than in Japan, the goods are made as cheaply as they can be made in the East, because the work is done with machinery.

Beyond a few ornamental chairs and tables, the bamboo curtain is the first popular use to which bamboo has been put in this country. It probably will not be the last, for bamboo has a habit of making itself so useful wherever it goes that its acquaintance is cultivated. The raw material has to be imported, for bamboo has not yet been raised successfully in this country. The Chinese in California have tried it, but without any great success. Some lonely trees grow in St. Augustine, in Florida, but they are mere travesties upon the real bamboo of the tropics. At Fort Myers, in the same State, 200 miles further south, there are better specimens, notably in the grounds of Thomas A. Edison's winter residence. There are some also at Tampa, and a few at Key West. But none of these, even with careful cultivation, gives any idea of the gigantic, stately, feathery bamboo of hot countries.

For commercial purposes bamboo comes to this country in the holds of sailing vessels, tied up in long cylindrical bundles; and the packages of it that one may frequently see unloading in South street are not good samples of the bamboo of the East Indies, except for business uses. The immense stalks, sometimes a foot thick and sixty feet long, seldom come here, because they are not needed. Our bamboo goods are better made from small growths, and it is not much matter whether the stalks are straight or crooked. They are often crooked, but they are easily straightened. From the ship they go to the factory; and one of the largest makers of bamboo goods in Brooklyn gives to a *Sun* reporter this account of their manufacture in this country:

"Our raw material," he says, "comes principally from China, Japan and India. In these three countries we find more than sixty varieties, ranging between two feet and sixty feet in height and half an inch and eight, ten, twelve inches in diameter. Every one of these varieties is noted for its durability, its great tendency to bend when steamed, its unique property of splitting into pieces of any thickness desired, and the high polish it will take. For any of these qualities no other wood compares with it. In some varieties the joints are only from five to eight inches apart, and in others they are upward of five feet apart. These larger kinds are rare and are used only in the manufacture of the more costly furniture.

"What bamboo articles do we make? A great many, and still not nearly as many as we might, nor as many as we probably shall when Americans come to know bamboo better. We make Sidarris, or Japanese cur-

tains, screens, fretwork, baskets and hampers, fancy boxes, parasols, chairs, stools, flower stands, settees, hat racks, tables, cabinets, brackets, easels, portieres, scrolls, and fancy woodwork of every description. Most of these things, you will notice, are fancy articles. Plainer and more useful things will come in time. As soon as there is a demand for them we are ready to make half the furnishing and fitting of a house from bamboo.

"Such as what, you ask? Water buckets, for instance, to begin with. There is no better water pail in the world than a section of big bamboo fitted with a solid bottom and a handle. Then bottles, ornamental columns, fancy water pipes, whetstones—far too many things, in fact, for me to mention. Among the more important I may mention flower pots. You have no idea of the beauty of bamboo flower pots unless you have seen them, and there is no end to their durability. In the botanical gardens of Jamaica, at Castleton, thousands of these bamboo flower pots are in use, ranging from 3 inches to 1 foot in diameter, each fitted with a wooden bottom. They cost a fraction of a cent each, and they last forever.

"You are surprised at my mentioning whetstones among the products of bamboo? It makes capital whetstones, being as hard as flint. In Eastern countries the natives frequently make knives of it. But that requires the best kind of bamboo. Only three species of the plant grow in this country, and they are all inferior kinds. The Chinamen in California have raised considerable quantities, but the quality is not good.

"We regard bamboo as a mammoth sort of grass. It bears a flower, and sometimes, though not often, produces seed. The stalks decay and drop away, but new shoots rise to take their place. The tips and buds are edible, and in times of want the natives live upon them. The leaf of the plant is succulent, and is often fed to cattle. We could use American bamboo for some purposes, but it is so cheap in the East that its cultivation in this country could hardly be made profitable. It reaches us generally in the Chinese-American merchantmen, and bears very close stowage. The only secret in our business is the use of steam, and that is no secret at all. Hard as bamboo is, when steamed it is as pliable as putty, and may be bent into any desired shape. We put the stalks into long steam boxes, and steam them until they are almost pulp. While in this state the crooked ones are straightened, and the various articles are made. They are then dried and become as hard and substantial as they were before. We have large rooms expressly for the drying of finished articles with artificial heat. After the drying, whatever fancy touches are needed are put on with a hot iron. That is the only satisfactory way, for when the bamboo is dry, it is so hard that it is difficult to work it, even with the best instruments.

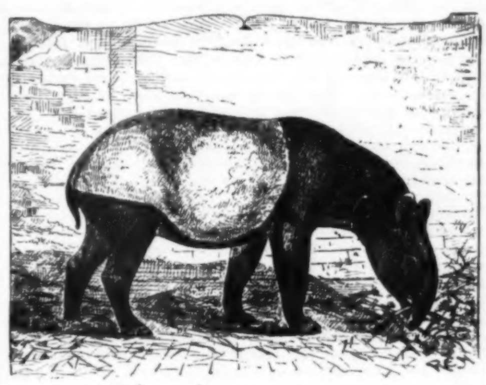
"Those joints in the bamboo curtains? You will readily see how the joints in a dozen strips are exactly parallel when you see how they are made. The stalk is run through a 'splitter,' a little machine which cuts ten, twenty, perhaps fifty strips from each stalk, making them of any width or thickness desired. These strips are then taken up by the binders, the cords which hold them together in the curtain, and if the bamboo is a large one, the same knot or joint may run through fifty or a hundred strips.

"We do not put as many fancy touches to our bamboo work as the foreigners do. Nearly all foreign bamboo work is highly ornamented. When you see a plain piece it is almost sure to be of American manufacture; but ours is strong and serviceable. You can distinguish American goods in another way. We make fifty tables, a hundred, a thousand, and they are all alike, because they are made by machinery; foreign goods are made by hand, and seldom two pieces are precisely alike.

"Do not confound bamboo work with goods made of rattan. Bamboo is hollow and knotty, while rattan is solid and fibrous. Rattan is a product of a species of palm tree, and has little in common with bamboo. We make in this country about $800,000 worth of bamboo goods every year."—*N. Y. Sun.*

THE MALAYAN OR ASIATIC TAPIR IN THE "ZOO."

AN addition of special interest has just been made to the collection of animals in the Zoological Society's Gardens, Regent's Park, in the form of a nearly adult specimen of the Malayan or Asiatic tapir. It is only at very long intervals that specimens of this interesting animal have been obtained, the first being in 1840, the second in 1850, one in 1882, and the present example, which arrived recently. The home of the tapir is in Central and South America, where there are three well-known species, viz., Baird's tapir, the hairy-eared tapir and the common or Brazilian tapir. Of the latter there are always living specimens in the gardens, where they have bred with tolerable frequency. The Malayan tapir has only been known to European naturalists since 1816. The specimen from which our illustration has been taken is a male, and has been deposited by the Hon. Walter Rothschild, F.Z.S., and may be seen in the large house set apart for the exhibition of the zebras and wild asses. It is perfectly tame and docile.—*Pall Mall Gazette.*



THE MALAYAN TAPIR.

THE GREAT STEEPLE CHASE OF PARIS.

PRINCE SAGAN is a first-class organizer; we dare not say an impresario, as we rarely find one of these. He has been able to make of the Auteuil hippodrome the most charming race course that exists.

But the horses? Oh, well, on the day of a great steeple chase, people outside of the habitues pay so little attention to them that it is truly hardly worth while to speak of them. In fact, what matters it to this elegant assemblage whether the legs of Surcouf, the French champion, are a little too stiff, and what cares it for the blinds worn by the English favorite, Red Prince II., which, judging of it by such appearance, does not possess a precisely comfortable character. No one thinks of putting himself out to go to see them. One speaks of the English, of the French, for which, despite his apparent skepticism, he makes the most ardent vows; but a much greater importance is attached to the elegance of the toilets, that one criticises in nibbling a sandwich or in sipping a finger of port wine.

The two favorites have not responded to expectations. Skedaddle, an animal forsaken by everybody—even by its owner—gained at the goal a victory that none was any longer in a state to dispute with him. His owner, Mr. Childs, who bought him a few weeks ago for a relatively small sum, made an excellent bargain. His jockey, Mr. G. B. Neillac, exhibited a tact and patience worthy of a rider of the first rank; but it must be added that the seven horses that disputed the prize of $24,000 were not worth, all of them, half this sum. They played their *role* well, after all, and we have nothing more to ask of them.—*L'Illustration.*

CAN DOGS TALK?

By W. C. FLOOD.

IT has been calculated, we believe, that for the requirements of his everyday conversation the vocabulary of a well-educated man contains about five thousand words, although one of exceptional genius might employ three times that number, whereas an ordinary person makes use of not more than two or three thousand words, and an uneducated agricultural laborer is possibly content with a few hundreds. The language of some savages is even more meager in its vocabulary; in fact, with certain tribes language resolves itself almost into its simplest form, and conversation cannot well be carried on in the dark, because signs and gesticulations are with them almost as important as speech itself.

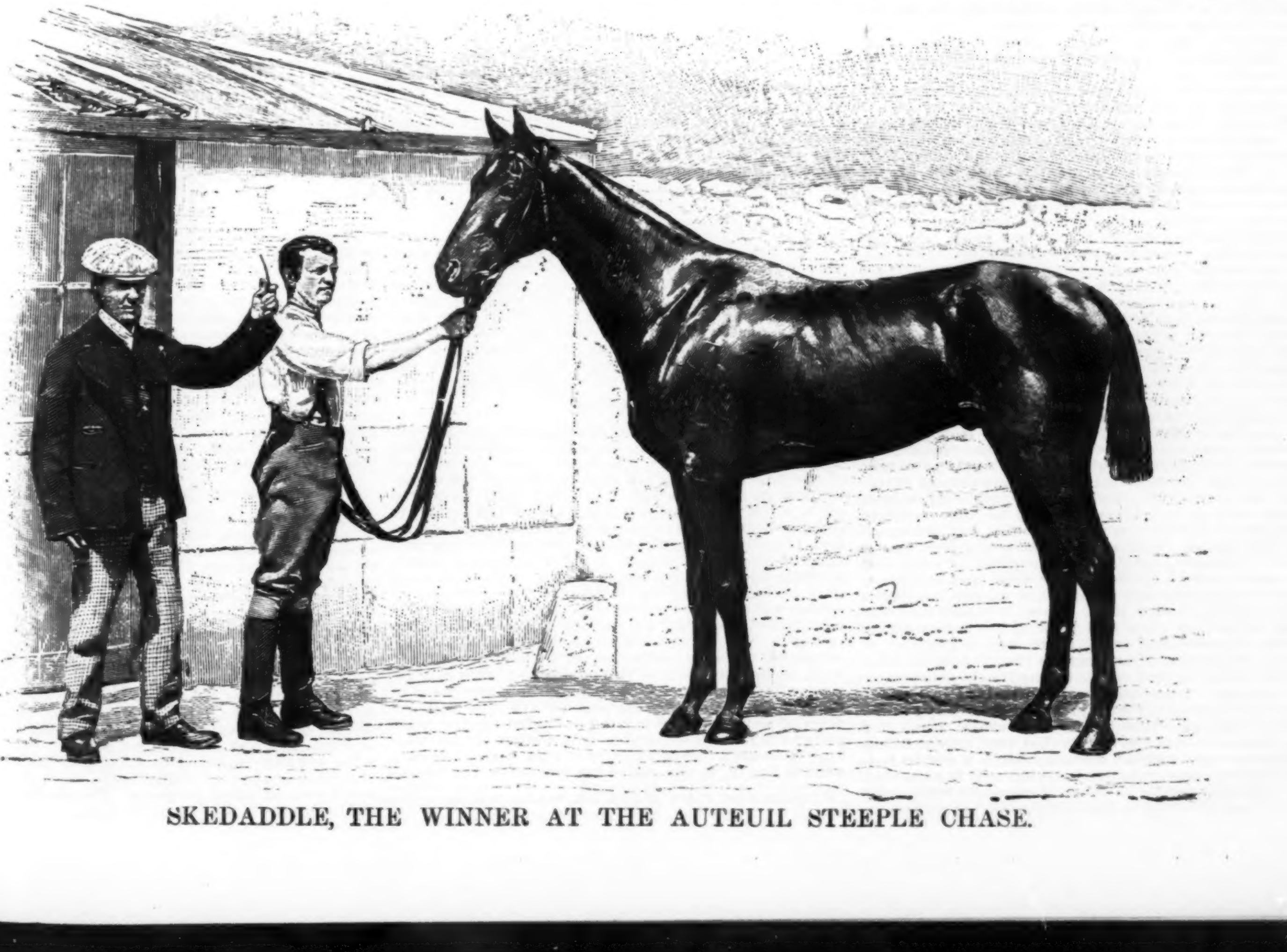
Bearing in mind that such scanty and imperfect language suffices for the requirements of some men, one would possibly not be too presumptuous in crediting many of the lower animals with the power of speech in a simple or rudimentary form. In fact, most of us have pet animals of some kind, and by constant association with them we learn to understand with more or less accuracy the means which they adopt to express their wishes. Most particularly, perhaps, is this the case with dogs, for these animals are the ordinary pets and companions of man, and they have, moreover, the power of emitting a great diversity of distinct and easily distinguishable sounds.

So far as taking part in a discussion, or even carrying on a simple conversation, a dog cannot talk. In fact, it may be safely asserted that man alone enjoys the gift of speech in the ordinary acceptance of the word. But if we recognize as language the power of expressing certain desires and emotions by means of well-defined and easily distinguishable sounds, then the dog has as much right to be credited with the power of speech as man himself.

The language of a dog, if it may be dignified by such a name, is, of course, language in its simplest form—simpler, in fact, than that of even the most primitive savage race with which man is acquainted at the present day. There appear to be in the canine tongue no separate words for food, drink, or anything else which a dog may want. The latter simply intimates that it wants something, and as a rule it is only the attendant circumstances which enable us to understand what may be required. A whine is frequently, but not always, used for this purpose. When barking is resorted to, the barks are usually single ones. Sometimes, too, a short growl is used.

Primarily we may place most of the sounds which a dog usually makes under the following six headings: Whine, howl, growl, bark, yelp and the squeak or squeal. Some of these, as the bark, may be subdivided into several distinct varieties, and when we also take into consideration the difference caused by intonation, we find that this number is still further increased.

The tone in which a dog barks or growls is not less important than the bark itself; but it is by no means



SKEDADDLE, THE WINNER AT THE AUTEUIL STEEPLE CHASE.

so easy for an inexperienced ear to distinguish all the varieties of expression.

The bark of a dog appears to be generally looked upon as the characteristic noise which this animal makes. Probably the most frequent, it is certainly the most noticeable, and is capable of greater variation than either of the other sounds we have named. Thus among the different kinds of barking we may mention as being the most easily distinguished are two which for convenience we will name the bark of interrogation and the bark of warning. The former is a single bark, sometimes preceded by and joined to a kind of growl. It is used when the dog hears, or fancies it hears, some unusual sound, and evidently means "What is that?" or "Who is there?" and may be regarded as an equivalent to the challenge of a sentry on duty. Should a dog have no doubt in its mind, however, that something is wrong, as, for instance, when the footsteps of a stranger are heard on the premises, it will give utterance to what we have styled the bark of warning, which consists of several "bow-wow-wows," delivered furiously in rapid succession.

Whether the dog addresses itself to its master or to the person at whom it barks is not quite clear, but probably the intention is, while acquainting the former with the fact that something is wrong, at the same time to inform the latter that his presence is known, and that if he misbehaves himself, or possibly, if he does not beat a retreat without loss of time, he may have to answer for some very unpleasant consequences. Frequently, when one dog hears another barking in this particular way, it will raise its own voice in a similar manner, even though it cannot see or hear the cause of the disturbance.

A form of barking somewhat similar to the foregoing, but nevertheless easily distinguishable from it by the practiced ear, or indeed by most people who have paid much attention to dogs, is the noise made by one when it is pleased, or when it is welcoming its master.

The sound commonly called whining is usually made by dogs when they are in some trouble. In certain cases it might perhaps be taken as an equivalent for crying or sobbing; but it may generally be regarded as an appeal for help. Thus a dog that is shut up, or chained up, will whine to be released. Frequently, too, a dog will whine when something that it wants is out of its reach, although, as we have already said, a bark is often used at such a time.

The "yelp" is a shrill kind of bark, or what one might term a cross between bark and whine. It is often used in conjunction with, or instead of, the latter; but it probably indicates a greater amount of excitement or anxiety, the degree of excitement regulating to a great extent the rapidity of the yelping. For instance, when a dog is excitedly chasing a cat or a rat under circumstances which make it fear that it may lose its prey, it will give vent to a rapid succession of yelps, whereas, when appealing for its release from captivity, the yelping is usually slow, the cries, separated by more or less prolonged intervals, being quite distinct from each other.

The majority of people are apt to look upon growling as a sign of ill-temper; but in reality dogs make two distinct sounds, which, although somewhat similar, are nevertheless of very different import. One, it is true, indicates rage, or growing anger, and is the growl which precedes a bite. It is a low note with a good deal of vibration. The other growl is generally in a somewhat higher key, with a more or less pronounced nasal sound, and is indicative, not of surliness, but of good temper, for it is used only when the animal is at play.

The "squeak" or "squeal" is never used except when the dog is subjected to sudden fear or pain, and is probably an involuntary sound, synonymous with the human scream—a cry common, no doubt, to all mankind—which, uttered under like circumstances, is equally involuntary.

We have not classified the easily recognizable cry uttered by dogs while they are fighting. It is, in fact, a mixture of barking, yelping, growling and squeaking, doubtless an involuntary venting of the passionate emotions that might possibly be regarded as a canine counterpart of the profane swearing occasionally indulged in by man himself when similarly engaged.

From the foregoing examples—which, by the way, are only a few of those that might be given—the reader will easily understand that a dog is capable of giving utterance to a far greater variety of sounds than are comprised in the conventional bark. It will be seen too that the canine language, if it can be so called, is one in which sounds that are practically almost identical may not always convey the same meaning, while on the other hand several different cries may be used for the same purpose. It will be found, however, on careful observation, that the tone of a dog's voice is in a great measure the key to the meaning which that animal wishes to convey by the sounds to which it gives utterance, the latter being in many cases adapted to circumstances, at times, in fact, being employed somewhat as one might regulate the use of certain words for the purpose of giving more or less force to an expression.

In studying the significance of the sounds that dogs are capable of making, it is not always easy for us to tell how far those sounds have been the result of intentional or accidental training. The language of man himself may be regarded as an acquirement rather than a natural gift, and possibly the only sounds which may be considered natural to him would be common to the human race generally, and expressive of such simple emotions as pleasure, anger, fear or pain. Similarly, certain sounds emitted by a dog may be considered as artificially acquired, and capable of more or less cultivation, though in a much less degree than is the case with man. Thus, it is said that wild dogs never bark; but that barking has been acquired in the domesticated state, as though it were an attempt on the part of our canine friends to hold intercourse with us and make themselves to some extent understood. A dog can easily be trained to bark on particular occasions and in a particular way; and it will, moreover, evidently be well aware what such barking is for, and the results that are likely to follow. Thus we may without difficulty teach a dog to bark for its food, and evidently knowing well the reward it will probably get for so doing, it generally barks when it sees anything edible that it may take a fancy to.

How far this process of linguistic cultivation can be carried, and to what extent it can be transmitted to subsequent generations in the case of dogs, we are not prepared to say. With man himself it would seem to be practically unlimited, and it is probably not impossible that some patient and persevering individual may eventually succeed in producing remarkable developments in "dog talk," even though the latter may fall far short of the ordinary conception of language. —*Science Gossip.*

SOUTHAMPTON SEWAGE PRECIPITATION WORKS AND REFUSE DESTRUCTOR.*

By WILLIAM B. G. BENNETT.

EARLY in 1885 the corporation of Southampton considered it expedient to introduce a more efficient system for the collection and disposal of house refuse; and at about the same time they found it desirable also to clarify by precipitation the sewage of a particular district of the town, which was being discharged in its crude state direct into the Southampton water at the town quay. Having been instructed to devise a scheme for accomplishing these objects, the author proposed the adoption of a refuse destructor for destroying the ash bin contents and garbage of the town, and also that the sewage sludge should be transmitted to the destructor from the two existing reservoirs in which it was deposited in the process of clarification. These reservoirs are each 100 feet long and 60 feet wide, and at the lowest end 10 feet deep. Formerly the sewage of a district of the town, amounting to 500,000 gallons in twenty-four hours from a population of about 13,000, for the most part flowed by gravitation into these reservoirs, whence it was discharged into the tideway at low water; while a small portion, coming from a low-level sewer, passed direct into the tideway through iron pipes laid under the reservoirs. The reservoirs act alternately, one being left still for precipitation of the sewage while the other is being filled.

PNEUMATIC EJECTORS.

In order to render independent of the tide the discharge of the clarified effluent from the reservoirs and to raise the low-level sewage into the reservoirs for treatment with the rest, two pneumatic ejectors were erected, both of which are worked by power obtained from the destructor. The smaller, of 360 gallons' capacity, is placed in the east reservoir, below the invert of the low-level sewer, and serves for transmitting the sludge from the reservoirs to the destructor, as well as for raising the low-level sewage; and the larger, of 700 gallons' capacity, is placed in the east reservoir for discharging the clarified effluent into the Southampton water. There is also a third ejector, of 300 gallons' capacity, which deals with the sewage of another district of the town near the destructor works, and is likewise worked by power obtained from the destructor; with an air pressure of 12 pounds per square inch, it raises the sewage about 18 feet from a low-level sewer to a higher one. This ejector was formerly worked by an independent steam engine, costing for coal about £120 per annum, which is now saved since the adoption of the destructor.

The sewage gravitates from the sewers, through the inlet pipe, into the ejector, and gradually rises therein until it reaches the underside of the bell. The air at atmospheric pressure inside the bell is thus inclosed, and the sewage continuing to rise outside above the rim of the bell compresses the inclosed air sufficiently to lift the bell, the spindle of which then opens the compressed air admission valve. The compressed air thus automatically admitted into the ejector presses on the surface of the sewage, driving the whole of the contents before it through the bell-mouthed opening at the bottom and through the outlet pipe into the iron rising main or into the high-level gravitating sewer, as the case may be. The sewage can escape from the ejector by the outlet pipe only, because the instant the air pressure is admitted upon the surface of the sewage the non-return flap valve on the inlet pipe falls on its seat and prevents the sewage from escaping in that direction. As the sewage flows out of the ejector, its level therein falls to that of the cup; and still continuing to lower, it leaves the cup full until the weight of the stuff in the portion of the cup thus exposed and unsupported by the surrounding sewage is sufficient to pull down the bell and spindle, thereby shutting off the admission of compressed air to the ejector. The compressed air remaining within the ejector then exhausts through an air escape valve in the top, which is opened by the fall of the cup and spindle; and the sewage outlet non-return flap valve falls on its seat, retaining the sewage in the rising main. The sewage then flows once more into the ejector through the inlet, driving the free air before it through the air escape valve as the sewage rises; and so the action goes on as long as there is sewage to flow. The position of the bell and cup floats is so adjusted that the compressed air is not admitted until the ejector is full of sewage, and is not allowed to exhaust until the ejector is emptied down to the discharge level.

RESERVOIRS.

In each reservoir there is a floating sewage inlet, consisting of a pipe hinged to the larger or effluent ejector and shackled to a buoy; the latter causes the free end of the pipe to rise and fall with the level of the liquid, keeping its mouth, which is covered with perforated plate, a few inches below the surface of the liquid, in order to prevent the entrance of any floating solid matter. Directly the clarification by precipitation has been effected to a certain depth, a valve is opened admitting the liquid into the larger ejector, whence it is at once discharged into the tideway. A supplementary sewage outlet is also provided in each reservoir for discharging the liquid by gravitation when the tide is low enough. When the whole of the liquid has been thus drawn off, the buoy, resting upon the floor of the reservoir, keeps the mouth of the inlet pipe high enough to prevent the entrance of any sludge into the larger or effluent ejector, and by opening a valve the sludge is then admitted into the smaller or sludge ejector situated at the lower level, and is transmitted by air pressure through a line of 4 inch cast iron pipes, about a mile in length, to the destructor erected on the Chapel Wharf. An air pressure of 40 pounds per square inch is required for working the sludge ejector and of 10 pounds for the effluent ejector.

PRECIPITATION.

Ferrozone is used for precipitating the sludge; it is mixed with just enough clean water to make the whole into a stiff paste, which is led through a shoot into a box with perforated sides placed in the sewer. The sewage flowing past washes the ferrozone gradually out of the box, and is thoroughly mixed with it by the time it discharges into the reservoirs at a manhole 150 feet distant from the box. A small stream of water falling upon the ferrozone prevents it from consolidating. The box is filled three times in twenty-four hours, and this method of dosing the sewage has proved quite efficient and satisfactory.

MANURE MIXING.

On arriving at the destructor the sludge is delivered into a cell, from which it is drawn as required through a valve pipe; and after mixture with road sweepings or sorted house refuse it is turned out as a good manure, which from the commencement has all been readily bought by agriculturists at 2s. per load delivered at the works. On an average, sixty-seven cart loads of ash bin contents are daily collected and disposed of, the ascertained weight of the load in each cart averaging a little under 17 cwts. The road sweepings are never burnt; but to keep pace with the demand, the sludge is run into bays made of the road sweepings, and is also filled in with them. The quantity of road sweepings thus utilized amounts in twenty-four hours to about 8 tons. Arrangements were provided at first for burning the sludge, for which purpose it was discharged into a tank on the floor of the destructor and drawn out through ports in the front, opposite the feed openings of the firing chambers, where its moisture was absorbed by the ash bin contents, which were backed up against the ports with this object, and the mixture was then raked into the fires. Large quantities of sludge were thus destroyed; but the process has since been discontinued, owing to the ready sale of sludge when prepared for manure.

DESTRUCTOR.

The refuse destructor has six chambers or furnaces, each capable of burning 8 to 11 tons of garbage per day. The products of combustion pass through a 30 horse power multitubular steel boiler in the main flue into a furnace shaft, which is of circular brick work, 160 feet in height from the ground line, 6 feet inside diameter at top, and 7 feet at bottom. The shaft is constructed upon a pedestal 14½ feet square and 24 feet high, of brick work 3 feet thick; and thence upward in four sections, of which the first is 27 inches thick and 30 feet high, the second 22½ inches thick and 30 feet high, the third 18 inches thick and 38 feet high, and the fourth 14 inches thick and 38 feet high. The first 30 feet [of this shaft] is lined with fire brick, and behind the lining is a cavity 4½ inches wide, which is ventilated by apertures to the outside of the shaft. The foundation is loamy clay, upon which is laid a bed of concrete 30 feet square and 10 feet thick. The footings commence at 23 feet 2 inches square, and step off in regular courses upward to 15 feet square at a height of 6 feet. The concrete was filled in continuously until completion. The pedestal was then run up and allowed to remain for nearly three months during the winter, after which the work was proceeded with until completion, occupying about six months more. The cap is white brick in cement, with a string course about 20 feet below the top. Foot irons are built inside in a winding lead up to the top. The shaft is provided with a copper tape lightning conductor, with iron rod and crow's foot 7 feet above the cap; the tape is about 215 feet long, the bottom end being carried into a well. In August, 1888, the shaft was damaged by lightning, but was easily repaired, owing to the provision of the foot irons built inside it. At that time the shaft was plumbed, and was found to be quite vertical. The fires were only damped down during the repairs, which occupied about eight days. With the exception of this interval they have been constantly burning for nearly six years. The repairs have been almost nil. There is also a by-pass from the destructor to the shaft for enabling the burning process to be continued when the boiler in the main flue is not required or during cleaning and repairs. No obnoxious fumes from the combustion have been perceived.

STEAM POWER.

The steam generated in the boiler is employed for driving a pair of engines of 31½ indicated horse power, which compress air into two large receivers at Chapel Wharf, whence it passes through a 5 inch main to the town quay, where it is automatically supplied to the ejectors when required for working them. The air also serves for driving the precipitated sludge through the 4 inch main from the reservoirs to the destructor, for which purpose the air is led by a pipe from the receiver at Chapel Wharf to the head of the main at the town quay. A 6 horse power engine, used in connection with the machinery for the preparation of fodder for forty horses at the corporation stables, is also driven by steam from the same boiler that supplies the air-compressing engines.

UTILIZATION OF SLUDGE AND REFUSE.

All obnoxious matters are collected throughout the borough in covered iron tumbler carts of 2 cubic yards' capacity, which go up the inclined roadway approach to the destructor and discharge their contents into the firing chambers. The road sweepings are frequently discharged into a hopper over an incorporator driven by a small engine and are mixed with the sludge as required; this is generally done in wet weather. The residue from the continuous day and night combustion consists of about 20 per cent. of good, hard clinkers and sharp, fine ashes. The clinkers are used for the foundation of roadways and the manufacture of paving slabs: the latter have already been used in paving several footpaths of the town and the new public baths at a cost of 2s. 6d. per square yard. The fine ashes are also employed for making mortar, with which the stables and swimming baths have been erected, and for many other purposes. The mortar is also sold to builders at 7s. 6d. per cubic yard.

* From the report of J. P. Bradley, U. S. Consul at Southampton, England.

ELECTRIC LIGHTING.

The waste heat from the destructor is utilized for producing electricity. The air-compressing engines drive a dynamo of 150 volts. At the present time the works are lighted with two arc lamps of 3,000 candle power each and twelve incandescent lamps of 16 candle power each; and four streets in the vicinity of the works have been lighted experimentally for the information of the corporation, which from the successful results obtained, resolved to extend the installation to the municipal offices, a town clock, the Hartley Institution and the town hall at the Bar Gate. For this purpose it was proposed to place accumulators in the basement of the municipal building, and charge them through a cable from the works. Circumstances having led to the abandonment of the street lighting, the public became financially the losers, and a private company is now supplying consumers.

OTHER USES.

The destructor is also employed in lending a helping hand to a neighboring authority by supplying to the local board of Shirley and Freemantle, about 2½ miles from the works, sufficient compressed air to work ejectors which they have erected in connection with the disposal of their precipitated sewage sludge from a population of 15,000. The compressed air is conveyed through a 4 inch main from the destructor works to their precipitation reservoirs, thus saving them the cost of a pumping station, and bringing to the corporation a return of £200 a year, which is received for the compressed air. Thus the destructor works are now dealing with the sludge of nearly 30,000 inhabitants.

COST.

The initial cost of the complete destructor—including engine house, inclined roadway, chimney shaft, boiler, and ironwork—was £3,723 ($18,116.11), and the sewage disposal works on the town quay cost about £3,000 ($14,598). This is exclusive of the Shirley and Freemantle works, which consist of three reservoirs very similar in construction to those at the town quay.

The annual expense for burning refuse is as follows:

Description.	Amount.			
	L.	s.	d.	
Two stokers, one by day and one by night, at 25s.	130	0	0	$632 58
Two feeders, one by day and one by night, at 23s. 4d.	121	6	8	590 39
Total per annum	251	6	8	1,222 97

VALUE OF REFUSE AS FUEL.

The quantity of refuse burnt per day of twenty-four hours is a little over 50 tons, so that the cost of burning is about 3½d. per ton. The minimum quantity burnt per day of twenty-four hours is about 25 tons, which has been sufficient to maintain steam for the engines of 31½ indicated horse power. This is equivalent to 16 cwt. of refuse per indicated horse power for twenty-four hours, or 75 pounds of refuse per indicated horse power per hour.

The annual expenditure for the sewage clarification and disposal is as follows:

Description.	Amount.	
Precipitating material for 365 days, averaging about 5s. per day	£90	$437 94
Engine driver and laborers at reservoirs	128	622 84
Two men at wharf mixing manure	104	506 06
Total per annum	£322	$1,566 84

REVENUE.

The amount realized from the sale of manure and for the supply of compressed air during last year (1891) was £600 ($2,919.60). The products from the destructor—including concrete slabs, clinkers used for concrete foundations, and fine ashes for mortar and for foundations of footwalks—represent about £300 ($1,459.80). To these may also be added the saving of the coal which was required for working the engines previously to the establishment of the destructor.

In a dispatch subsequent to the foregoing Consul Bradley transmitted a printed report, prepared by the engineer inspector of the local government board of London, from which the following extracts are taken:

BURNING SCREENED REFUSE.

The burning of screened or selected refuse under steam boilers is in practice at Manchester, Bolton, Glasgow, and Birmingham. At the three first named places large grate area, a thin fire, and frequent clinkering and firing are depended on; but at Birmingham there are special arrangements which deserve notice. At the Montague Street wharf, where by far the larger part of the refuse is burned under boilers to raise steam for drying excreta, there are thirteen multitubular boilers, eleven of them 13 feet long and two 11 feet long, and all 6 feet 6 inches in diameter. They have fire grates 5 feet wide and 5 feet 6 inches long, fitted with patent lifting and moving fire bars, designed to break up the fire and prevent clinkers forming in large cakes and to keep the spaces between the bars clear. The play of the bars can be regulated to suit the kind of refuse burning, or it can be stopped entirely. The effect when in use is to work the clinker to the back, where it falls over the end of the fire grate and is removed when cool from the ash pit. The refuse burned under these boilers is that from which the fine ashes have been screened for mixing with excreta, and there is no difficulty in maintaining steam at sufficient pressure to be used for drying excreta. There are, besides, two Galloway boilers, 27 feet 6 inches long and 7 feet 6 inches in diameter, fed with cinders screened from the refuse and mixed with slack, which raise steam for two 25 horse power engines which drive the machinery of the yard.

THE FIRE DESTRUCTION SYSTEM.

The escape of dust and of smell from the chimney must be regarded as defects to be remedied, especially where the air is not already polluted by factory chimneys. Much in the way of prevention may be effected by careful and systematic firing and feeding, combined with large flues or dust chambers, frequent removal of dust, and proper regulation of the draught. When these precautions do not suffice, passing the products of combustion through or over a second fire appears to be the most promising means of destroying smoke or smell and preventing the escape of dust.

In other respects the burning of town refuse by furnaces already in use appears to be successfully carried out. There is no accumulation of an offensive material at the works, and very little smell. Everything combustible is burnt within a few hours of collection without nuisance and at a cost which compares favorably with the old system of carting the refuse to tips. A valuable means is at the same time provided for effectually disposing of infected bedding and clothing, condemned meat and provisions, and the carcasses of diseased animals. Further improvements may be expected, but the results already attained show that the destruction of the refuse of towns by fire is not only practicable, but is the best, and often the only, way of dealing with it in a manner to satisfy sanitary requirements.

BURNING DISEASED ANIMALS AND CONDEMNED FOOD.

Considerable care is now taken [in Leeds] with the charging and clinkering of the furnaces. At first all the cells were clinkered and charged, one after the other, every two and a half hours as quickly as the men chose to do it; but now a pair of cells are charged every twenty-five minutes regularly. The result is that the temperature in the main flue is more uniform, and there is less smoke from the chimney.

The fires are kept continuously alight, except when drawn for repairs. The furnaces are filled up and banked about 1 P. M. on Saturday, and the damper is closed at 7 P. M. till 12 on Sunday night. The amount burned in the year ended August 31, 1886, in twenty cells was 35,248 tons, giving an average of 34 tons per cell per week, consisting of refuse from ash pits, with trade and market refuse. Mr. J. Newhouse furnished the following list of other things destroyed during the same period: Eleven cows, 3 calves, 17 sheep, 4 goats, 298 hogs, 5 turkeys, 2 carcasses of beef, 28 quarters of beef, 9 cwt. of pork, 10 cwt. of pickled tongues, 12 cwt. of herrings, 218 cwt. of shellfish, 1 cwt. of sugar, 285 dogs, 109 cats, 13 foxes, 1 sea serpent; 147 mattresses, beds, pillows, and bolsters; 7 blankets, quilts, and sheets; 36 pieces of carpet, 7 hearth rugs and mats; 33 pieces of wearing apparel, 1 bedstead, 1 sofa, 1 chair, and 1 bundle of rags.

This is not an unusual year's work, and the destruction of diseased animals and condemned food is constantly effected without offense. On one occasion, on an outbreak of swine fever, 200 hogs were burned, and in one afternoon 50 were destroyed, 3 at once in a cell, only a faint odor of roast pork being perceptible on a hill to leeward of the chimney.

THE GERMICIDAL POWER OF DISINFECTANTS.

WITH a view to ascertaining the actual value of a disinfectant as a means of destroying microbes, Mr. A. B. Griffiths, Ph.D., has recently been making some interesting experiments. He took for his purpose various preparations of Sanitas, and as the most interesting results were obtained by the use of Sanitas oil and the vapor of the oil, it is to these that we shall confine our attention.

As stated by the investigator, in the case of pathogenic microbes, a substance, to be called a germicide, or disinfectant, must be shown to possess this power, that when the microbes are exposed to the substance, and then introduced into a nourishing medium, they must refuse to grow; and it must also be demonstrated that when introduced into susceptible animals they are incapable of producing the diseases which the same microbes, unexposed to the substance in question, do produce. It is also essential in the treatment of infectious diseases that not only the pathogenic microbes should be destroyed, but also the poisonous substances (ptomaines), which they indirectly produce. The best way of showing the value of the experimenter's work will perhaps be to deal with his experiments in detail. Six classes of microbian growths were taken and treated as follows:

Diphtheria.—Eight tubes, each containing 100 c. c. of nutrient gelatine, were inoculated with *Bacillus diphtheriæ* from pure subcultures of the microbe; and after three weeks' incubation at 20° C. ½ c. c. of Sanitas oil was added to each tube, and the incubation continued for four days. As a result, the microbes in each of the tubes were found to have been destroyed, as animals susceptible to diphtheria on being inoculated were unaffected.

Tuberculosis.—Four tubes, each containing 100 c. c. of solid blood serum, were inoculated with *Bacillus tuberculosis* from pure subcultures of the microbe; and after twelve days' incubation at 37° C. 1 c. c. of Sanitas oil was added to each tube, and the incubation continued for six days. But in each tube the tubercle bacilli were completely destroyed.

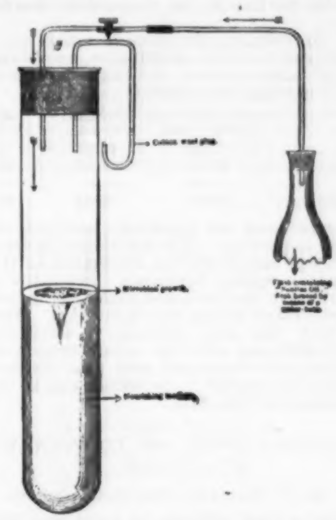
Glanders.—Six tubes, each containing 100 c. c. of solid blood serum, were inoculated with *Bacillus mallei* from pure subcultures of the microbe; and after three days' incubation at 38° C. ½ c. c. of Sanitas oil was added to each tube, and the incubation continued for a week. But in each tube the bacilli were destroyed.

Cholera.—Ten tubes, each containing 100 c. c. of bouillon (slightly alkaline), were inoculated with *Spirillum choleræ Asiaticæ* (Koch's microbe) from pure subcultures of the microbe; and after four days' incubation 1 c. c. of Sanitas oil was added to each tube, and the incubation continued for five days. But in each tube the microbes had succumbed to the action of the germicide. It was further demonstrated that it is quite impossible to inoculate gelatine plates (*i. e.*, plate cultivations) containing 1 per cent. of Sanitas oil with the microbe of cholera; although when the Sanitas oil was absent the microbes gave rise to colonies on the surface of the gelatine.

Typhoid Fever.—Four tubes, each containing 100 c. c. of nutrient gelatine, were inoculated with *Bacillus typhosus* from pure subcultures of the microbe; and after three days' incubation 1 c. c. of oil was added to each tube, and the incubation continued for six days. But in each tube the microbes were completely destroyed.

The 1-10 c. c. of Sanitas oil in 100 c. c. of bouillon was, however, incapable of destroying the microbe of typhoid fever; but 1 c. c. of the oil in 100 c. c. of bouillon prevented the development of the microbe.

Scarlet Fever.—Six tubes, each containing 200 c. c. of nutrient gelatine, were inoculated with *Micrococcus scarlatinæ* from pure subcultures of the microbe; and after ten days' incubation at 18° C. ½ c. c. of the oil was added to each tube, and the incubation continued for a week. But in each tube the microbes were completely destroyed. The same result was obtained when ½ c. c. of oil was added to pure cultivations of the microbe of scarlet fever in alkaline bouillon and milk (100 c. c. of each). One of the most convenient forms of disinfecting and perhaps one of the most searching is that based on the fumigating principle. It remains to be seen, however, if the vapor of the disinfectant thus distributed is as effectual as the same in a liquid form. Experiments were therefore carried out in this direction, the little apparatus which we illustrate hav-



ing been employed by Mr. Griffiths for the purpose. The flask containing the oil was placed in a water bath heated to 100° C. and the vapor of the oil thus passed over into the cultivation tube, as shown. The results obtained with this apparatus showed that the bacilli were destroyed as follows:

(*a*) Bacillus tuberculosis	in from	7	to 10	minutes
(*b*) Bacillus diphtheriæ	"	5	" 8	"
(*c*) Bacillus typhosus	"	6	" 8	"
(*d*) Bacillus mallei	"	7	" 10	"
(*e*) Spirillum choleræ Asiaticæ	"	10	" 15	"
(*f*) Micrococcus scarlatinæ	"	4	" 6	"

From this it is evident that the vapor itself possesses genuine germicidal powers and should be of service by inhalation in the treatment of diseases of the throat and lungs. Adverting now to the ptomaines referred to at the outset, a number of these have been prepared by the investigator from urine in certain infectious diseases. (*Vide* Griffiths' papers in *Compt. Rendus.*) Also several of these ptomaines have been obtained from pure cultivations of the microbes. With these ptomaines the following are some of the experiments made:

SCARLATININE ($C_6H_{11}NO_4$) is the poisonous ptomaine of scarlet fever, as it is always present in the urine of patients suffering from that disease; and it is also produced in pure cultivations of *Micrococcus scarlatinæ*. One-tenth of a cubic centimeter of Sanitas oil completely destroyed 0·76 gramme of scarlatinine; the products of oxidation, being non-poisonous, may readily be taken into the system with impunity.

DIPHTHERINE ($C_{14}H_{17}N_2O_4$) is the ptomaine of diphtheria. It is present in the urine of patients suffering from that disease, and is also produced in pure cultivations of *Bacillus diphtheriæ*. It is very poisonous, but is completely destroyed and rendered inert by the action of the Sanitas oil.

PROPYLGLYCOCYAMINE ($C_6H_{13}N_3O_2$) is the ptomaine of parotitis (mumps). It is very poisonous, and when administered to a cat it produced nervous excitement, cessation of the salivary flow, convulsions, and death. But the action of both the oil and Sanitas fluid rendered it inert.

GLYCOCYAMIDINE ($C_3H_5N_3O$) is the ptomaine of measles. It is poisonous, and when administered to animals, it causes death in from twenty-four to thirty-six hours. Sanitas oil and Sanitas fluid both destroy this ptomaine, and the products formed, due to the action of these powerful oxidizing agents.—*Chem. Tr. Jour.*

CLARIFICATION OF JUICE BY POWDER OF HYDRATE OF LIME.*

IN my memoir in response to the questions of the association, and in the discussion brought out by this memoir at the general assembly in the month of July last, I said that powdered hydrate of lime is more energetic than milk of lime in the clarification of juice; and have sought if the explanation of the fact was not, when powdered lime is used, not so large a quantity of water is used, and by consequence not so much salts introduced by the water. As our colleague, M. Vivien, has remarked, this cannot account for the incontestable superiority of this process, and we have sought to elucidate this question during the present campaign.

* B. Mittelman in Bulletin de l'Association des Chimistes de Sucrerie et de Distillerie de France et de Colonies.—*La Planter.*

Given the composition of our limestone, the percentage of silicic acid and magnesia, bodies which can influence defecation—the first in forming insoluble organic combinations—we cannot attribute any great importance to these bodies in the defecation of the juices, for they are contained in the limestone, but in feeble proportions—about 0·40 per cent. silicic acid and 0·129 per cent. carbonate of magnesia.

I then studied the reaction of lime upon sugar juices when applied separately in three different states—anhydrous lime, powdered hydrate of lime, and milk of lime at 20° Baume. The experiments were made in the laboratory upon the same diffusion juice and with an average sample of limestone, being very careful with all the conditions. A great many liters of juice were used for each case and treated exactly as in the sugar house, viz., heated to 80° C., filtered, 10 per cent. lime added in the three mentioned states, and carbonatated, the first time to alakalinity. After skimming, the liquid was saturated with 2·5 per cent. lime in its three states, carried to boiling point, filtered and analyzed.

Remarks.—The juice with the best color was that one treated by hydrate of lime. Let the decoloration be represented by 100, that treated by milk of lime would be 70, and that by the anhydrous lime by 80, although all precautions were taken. Besides, the solution of the quicklime required a long time, and this mode of work would be impossible, since often it took two hours for the lime to be changed to the hydrate of lime.

Results.—In bringing the juice of saturation to the initial density of the juice of diffusion, we obtained for 100 parts of saline matter and for 100 parts organic matter the following defecation:

Defecation.	Juice treated with milk of lime.	Powdered hydrate.	Quick-lime.
Saline..........	19·42	25·27	8·05
Organic........	30·46	48·25	22·98
Total.......	49·88	73·52	31·03

These results need no comments, and they are confirmed daily in practice. The inferiority of defecation with anhydrous lime should be attributed to the solubility of certain organic materials during the hydration of the lime in the juice and under the influence of the heat generated during this hydration. This confirms the fact that lime possesses a solubility in a sugar liquid differing with the concentration and the state in which it is employed, and that its power of combination with matter to be withdrawn is also different according to this state. J. T. C.

THE COMBINATION OF OXYGEN WITH HYDROGEN.

By H. N. Warren, Research Analyst.

A mixture of two volumes of hydrogen with one of oxygen remains inert until a light is presented to the same—so read our modern handbooks of chemistry. But oxygen, in admixture with hydrogen, becomes closer allied to water on increase of pressure, until a pressure of 180 atmospheres is attained, when combination takes place with fearful violence. The experiments which are thus presented by the author, of which a brief description will suffice, were constructed electrolytically, as may be readily observed to be the simplest and at the same time most efficient mode of dealing with the gases. Small selected glass tubes, into which two platinum wires were sealed, after introducing into each a c.c. of acidulated water and sealing the further extremity, were subjected to the action of an electric current of six volts. The rapid bursting of the first series of tubes, consequent upon the heating of the small quantity of liquid contained therein, at once suggested the cooling of the same by inserting the sealed tube and its contents in a strong glass vessel containing water. A tube thus mounted was next put upon trial; the electric circuit having been established, the experimenters meanwhile withdrawing themselves to a safe distance, carefully timing the effect.

In previous cases of trial the tubes had burst within three minutes after applying the current with a slight explosion; but in this case ten minutes had elapsed, and the action continued as energetic as ever. Fifteen and twenty minutes passed, and the action within the minute vessel continued as briskly as ever; exactly twenty-five minutes had elapsed when a vivid flash, succeeded by a violent report, terminated the experiment, shattering the glass vessel and scattering fragments in all directions.

Some force of the explosion may be understood from the fact of the sealed tube being but an inch and a half in length, and containing only one c. c. of water; nevertheless, portions of glass were hurled with sufficient force in the immediate neighborhood of the explosion so as to penetrate a wooden bench to the depth of half an inch, while an assistant some distance from the spot narrowly escaped severe laceration. Various other tubes were afterward experimented upon, affording similar results, the pressure, as arrived at by a careful average, amounting to 180 atmospheres.—*Chemical News.*

Constituents of Hops.—Briant and Meacham point out that hops owe their preservative power, according to Hayduck, to three resins they contain; α-resin, precipitated by lead acetate; β-resin, nonprecipitable by the same agent; and δ-resin, harder than β, while soluble in petroleum ether, which does not affect either of the others. A distinct antiseptic influence, especially upon lactic fermentation, is possessed by a, but it has no effect upon the acetic ferment and sarcina (*Pediococcus cerevisiæ*). All the resins are bitter, δ less so than the others, while a dissolves most readily. The constitution of the tannin of hops is said to be not yet understood, and there are believed to be several tannins present. The practical preservative power of hops is not always found to coincide with the proportion of tannin present. In hop oil various observers claim to have found a terpene-like body, an oxygenated hydrocarbon, valeric anhydride, which sometimes oxidizes to valerianic acid and imparts a peculiar cheesey odor to old hops, and cholin, a substance found also in brain and nerve matter. Little is known of the nitrogenous matters in hops, but the presence of small quantities of asparagine has been demonstrated. A fermentable sugar and diastase have also been shown to be present.—*Trans. Inst. Brew.*, vi., 149.

THE "POTATO TREATMENT."

Dr. J. Solis Cohen reports, in the Philadelphia *Medical News*, that a patient was brought to him several hours after having swallowed an irregularly shaped dental clasp. Exploration of the œsophagus showed that tube to be unobstructed. The patient was ordered to be fed exclusively on buttered mashed and roasted potatoes, and to examine his stools carefully for the foreign body. Within forty-eight hours it was voided, thoroughly coated with potato.

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